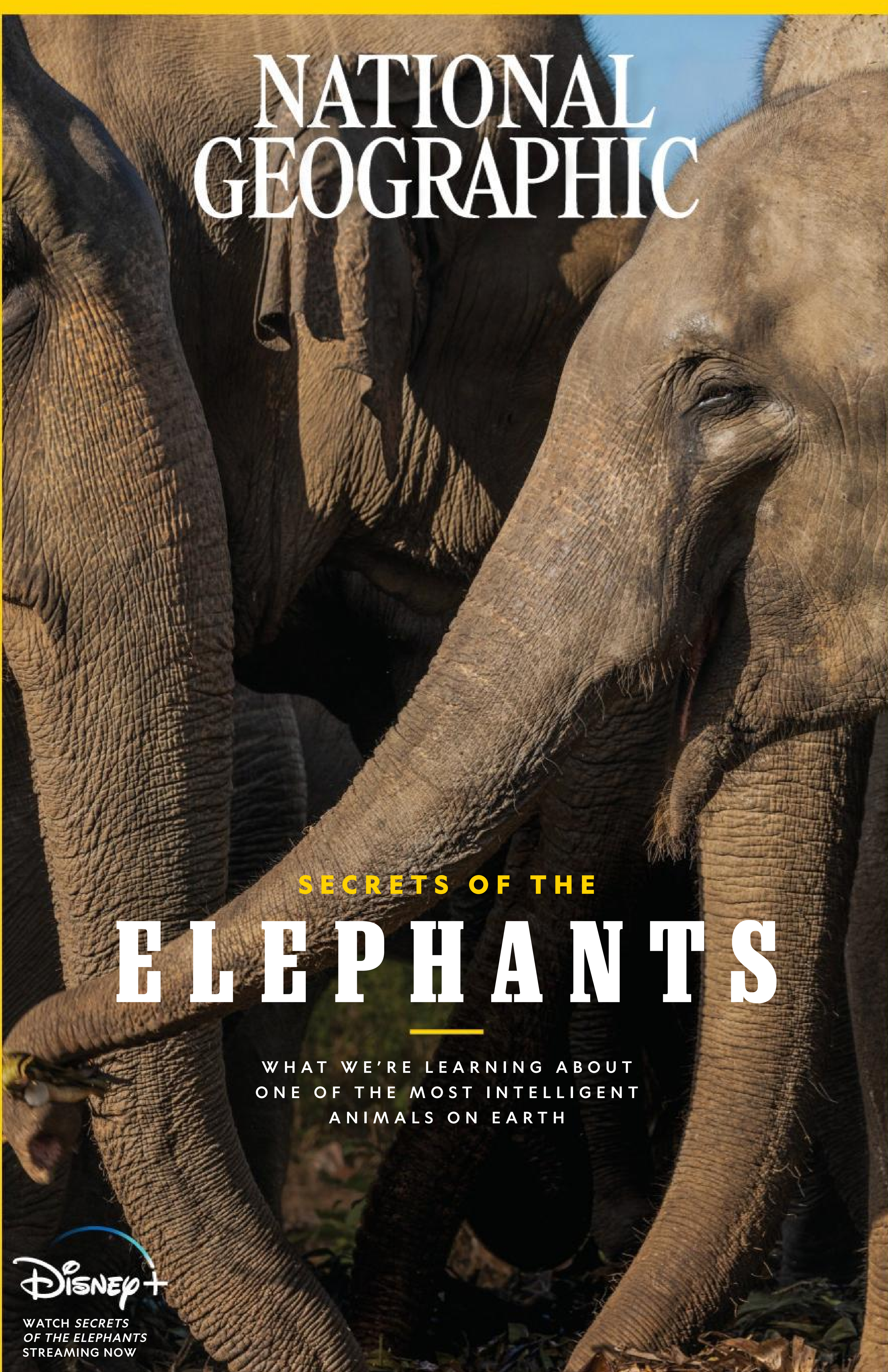
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NATIONAL GEOGRAPHIC



SECRETS OF THE

ELEPHANTS

WHAT WE'RE LEARNING ABOUT ONE OF THE MOST INTELLIGENT ANIMALS ON EARTH

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Paving the way to clean mobility.



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of the Year

2022
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BY **NATHAN LUMP** PHOTOGRAPH BY **BRENT STIRTON**

THERE ARE FEW SPECIES on the planet that fascinate us quite like elephants. With their long lives and enormous brains, their complex social networks, and, of course, those incredible trunks that do everything from grasping food to drinking and holding water, elephants feel both prehistoric in their majesty and also somehow like us. It's no surprise we've long associated them with intelligence, strength, and wisdom.

In the new series *Secrets of the Elephants,* on National Geographic and Disney+, National Geographic Explorer Paula Kahumbu takes you from Africa to Asia, across the varied ecosystems in which elephants live, to bring to life the biology, behaviors, and adaptations that make them one of Earth's most extraordinary creatures. You'll also meet people worldwide who are studying them and working to protect them. As elephants face ongoing threats, now is a critical moment for us to determine what we're going to do about it.

This issue offers a taste of what you'll learn about elephants in the series, and looks in depth at the Asian elephant. Though about a third of all Asian elephants are in captivity and many wild ones live in close proximity to people, we know much less about their social structures than those of their African cousins.

Photographer Brent Stirton and writer Srinath Perur reveal fascinating facts about these animals. For example: They're one of the few species (others include chimpanzees and dolphins) that pass the "mirror test": They can recognize their own reflection.

We hope you enjoy the issue.



Wild elephants always have lived in the native forests of Valparai, Tamil Nadu, India. But since the area was developed to create tea estates starting in the late 1800s, the animals have had to navigate these crops and other barriers in their migration corridors, and conflict has arisen between humans and elephants.


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Siamese fighting fish come in many shapes and colors, but this half-moon variety, named for the contour of its tail, is photographer Visarute Angkatavanich's favorite.

PROOF

PHOTOGRAPHS BY **VISARUTE ANGKATAVANICH**

LOOKING AT THE EARTH FROM EVERY POSSIBLE ANGLE



A FANTASY IN FINS

A camera lens shows the artful aspect of a common household pet, the Siamese fighting fish.



This dark green male was a challenge to photograph, says Angkatavanich, because its coloration is dull compared with other varieties. But the combination of spectacularly flamboyant fins and high activity made the image work.



With a fast shutter speed and a strobe flash, photography can reveal flourishes of these animals that are too subtle for the human eye, Angkatavanich says. In this shot, a red betta appears to become a bird of paradise.



The photographs on this spread, taken two years apart, portray different fish in the same position, something that Angkatavanich says almost never happens. He was stunned by his good fortune.



The photographer believes that each image also contains a hidden visage of sorts. On the left, for example, he sees a white-clad woman in the fish's fins; on the right, he sees a man in a dark robe.

THE BACKSTORY

CREATIVE INSPIRATION IS ALL AROUND US, SAYS THIS PHOTOGRAPHER. HE FOUND HIS MUSE IN A FISH TANK.

FOR AS LONG AS he can remember, Visarute Angkatavanich has been fascinated by fish. At age seven he took up photography, first with a disposable Kodak camera and later with his father's Nikon FM. But it wasn't until he became a dad and started spending more time at his home in Bangkok that he merged the two passions.

Angkatavanich studied the traits and care of Siamese fighting fish, also known by the apt scientific name *Betta splendens*. Then he procured some from a pet store in the city's Chatuchak Market and began photographing them, experimenting with different enclosures and lighting. "I can't ask the fish to act like people," he says, so he learned to coax them into various positions by changing the size and shape of the tanks. A tall tank, for instance, encourages a betta to dive down dramatically. Angkatavanich, who's now been focusing on fish for years, has a pretty good idea of what to expect next. But capturing the magic moment is still a challenge. He has to "press the shutter and hope for a miracle."

Angkatavanich understands the appeal of photographing creatures in far-flung places, such as birds in the Amazon rainforest. But he finds inspiration in his own home where, in the right light, the fish look like "moving color" in the frame of a painting, he says. Best of all, his subjects become part of his family. —JASON BITTEL



"This is the traditional pose for betta," says Angkatavanich. "Simple and elegant."

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Glowing Ghost Fungus
Anne Frank's Protector

ILLUMINATING THE MYSTERIES—AND WONDERS—ALL AROUND US EVERY DAY
NATIONAL GEOGRAPHIC | VOL. 243 NO. 5

5 Things Scuba Diving Taught Me

PLUNGING INTO THE OCEAN DEPTHS CAN SEEM INTIMIDATING. BUT IT CAN ALSO CHANGE YOUR MINDSET—AND YOUR LIFE.

BY **CARRIE MILLER**

D

DIVING MADE MY WORLD BIGGER. And I remember the moment it happened. I was descending through warm, clear water in Rarotonga, the largest of the South Pacific's Cook Islands, on my fifth dive.

Inexperienced divers are often busy divers, and so it was with me. I double- and triple-checked gauges, was hyperfocused on the feeling of breathing through a regulator, fretted in gear that felt claustrophobic, and used my arms to orient myself in the strange blue expanse, expending valuable energy. Diving is about being calm and measured. I hadn't learned that lesson yet.

But then I looked around and was stunned into stillness. I found myself in an enchanted forest straight out of a Grimms' fairy tale. Porites, a type of stony coral, burgeoned like giant mushrooms. Brightly colored lemonpeel and flame angelfish flickered around them. Sandy channels cut between the porites, white-sand ribbons over which squadrons of ocellated eagle rays

ASTRONAUTS REPORT FEELING AWED AND OVERWHELMED WHEN SEEING THE BEAUTY AND FRAGILITY OF OUR PLANET FROM THE INHOSPITABLE REACHES OF SPACE. AS AN AQUANAUT, I EXPERIENCED SOMETHING SIMILAR.

soared. Farther on, the forest morphed into a garden of *Montipora* coral colonies, giant rosettes providing cover for resting whitetip reef sharks.

I had been an avid snorkeler all my life, yet had no idea what I'd been missing. This was new. This was unexpected. Each dive since has been a revelation. From everything that diving has taught me, I offer these five lessons.

1. YOU MEET THE BEST PEOPLE.

Every hobby gathers a tribe, and divers form an eclectic one. I've dived with doctors who treasure the underwater world as an escape from their job demands, nomadic dive guides who forgo wealth and security for a life spent close to the ocean, and engineers with a passion for diving's technical aspects. They are, in their own ways, welcoming and helpful.

Diving is how I met my husband, Chris Taylor. The seeds for our maritime meet-cute were planted when we were children, me in Minnesota and Chris in Greece. As kids, we were both obsessed with sharks. Some 30 years later, I landed my dream assignment for *National Geographic*—a story about diving with great whites—and it was on this assignment, in Port Lincoln, Australia, that I met Chris, who was a dive supervisor and shark wrangler.

2. YOU AREN'T AFRAID OF SEEING SHARKS.

Divers are afraid of *not* seeing them. From zippy reef sharks to enigmatic tigers, sharks have charisma. They are spectacular creatures to be around.

Most sharks give divers a wide berth. Occasionally they are inquisitive, but in the hundreds of dives Chris and I have been lucky enough to share with sharks, we've never had a negative interaction. Sharks are also a talisman of sorts: An abundance of them in an area often signals a healthy ecosystem.

It's no coincidence that the Galápagos Marine Reserve—one of the world's sharkiest spots—is also one of the most biologically diverse marine protected areas, home to nearly 3,000 species. But even protected places like the Galápagos aren't safe from the devastation of illegal, unregulated, and unreported fishing. In 2017 a Chinese fishing vessel was captured there carrying more than 300 tons of endangered marine species, including 6,000 sharks likely slain for their fins.

Over the past 50 years, oceanic shark and ray populations have collapsed, declining by 70 percent. We need these predators. It's past time to flip the script and focus on sharks as endangered, not dangerous.

3. YOU GAIN A UNIQUE PERSPECTIVE.

Any image taken from space confirms that we live on an ocean planet, vast stretches of blue cradling scattered green-brown shapes. How strange that we call our planet "Earth," derived from a Germanic word meaning "the ground," when more than 70 percent of its surface is covered by ocean.

Though I grew up in a nature-loving family, it wasn't until I started diving that my conservation awareness kicked into overdrive. Humans are complacent creatures. We tend to take the Earth—our shared life-support system—for granted, unless a profound new perspective rends our point of view. Astronauts report feeling awed and overwhelmed when seeing the beauty and fragility of our planet from the inhospitable reaches of space. As an aquanaut, I experienced something similar.

I was in the Kerama Islands—about 22 miles west of Okinawa, Japan—finning from one coral outcrop to another, all of them bustling with reef life. Fish schooled in the thousands. Garden eels poked their heads out of the snow-white sand. Cleaner shrimp were removing parasites from waiting fish, and a pair of yellow-lipped sea kraits swam gracefully by, disappearing together into a hole in the reef. It reminded me of a lively city, each inhabitant going about its daily routine, just as we humans do.

All too often, though, these coral cities are polluted, choked by an overgrowth of algae, or tangled in fishing line. Rays and sharks swim past with mouthfuls of fishhooks. Plastic wrappers drift through water turbid with runoff. The reef life continues, but there's less of it, and the living seems harder. Although this Okinawan reef was still in relatively good condition, it was surrounded by 50-caliber bullets, remnants from World War II.

Diving has given me an appreciation for the interconnectedness and delicacy of life on Earth, greater than what I've experienced topside. Am I so accustomed to seeing humanity's far-reaching effects on land that I've become complacent? Perhaps. Witnessing them underwater, however, is a gut punch.

4. YOU TOO CAN BE AN EXPLORER.

If you're a diver, you're an explorer. More than 80 percent of the world's oceans are uncharted, and



A scuba diver explores a cave inside Casa Cenote on Mexico's Yucatán Peninsula. The area is known for cenotes, sinkholes flooded with groundwater, that attract swimmers, snorkelers, and divers.

PHOTO: PAUL NICKLEN

every dive is a new experience, never to be repeated. There's a common assumption that diving is hardcore and dangerous. It can be but doesn't have to be.

At a recent dive conference, I met Richard Harris, an Australian cave diver best known for his pivotal role in the 2018 rescue of a youth soccer team from Tham Luang cave in northern Thailand. He's completed other extreme feats, such as descending to depths of 803.8 feet while searching for the source of New Zealand's Pearse River.

Yet, he said with a grin, "I dive within my limits, just like you." True. It's just that my limits are much narrower. I'm fine with that, because there's so much that a recreational diver like me can experience.

Here are three examples: I can peruse the *Peristera*, a 2,500-year-old shipwreck holding more than 4,000 amphorae near the Greek island of Alonnisos. I can watch surgeonfish and yellow tang clean algae from the shells of green sea turtles off Hawaii. And I can marvel at Alaska's underwater world, filled with soft, white-plumed anemones, lion's mane jellyfish, giant Pacific octopuses, and spawning salmon.

Exploration is observation. Sometimes that involves pushing limits, journeying to the edge and beyond. Sometimes it involves slowing down, studying a species in minute detail. Wonder exists in both, and everywhere in between.

5. SCUBA DIVING MAY NOT BE FOR EVERYONE—BUT THE OCEAN IS.

I didn't take to diving immediately. It took me three years and three tries to get certified, but I'm glad I persisted. My first four dives were overwhelming, but if I hadn't continued, I wouldn't have had that mind-bending fifth dive. I wouldn't have seen those Okinawan coral cities. I wouldn't have met Chris.

Learning to dive is a lot like learning to drive a car: You study the theory, practice with an instructor, and become qualified. From there, proficiency depends on how often you dive, further training, and your own self-reliance. Regardless of your goals, diving is more accessible and wondrous than I ever imagined, and I'd encourage anyone to give it a try.

But not everyone wants to or can dive, and that's fair enough. Whether you're a snorkeler, surfer, kayaker, or sailor or you simply enjoy dipping your toes into the sea while on holiday, you can still be aware of the life unfolding under that glittering blue coverlet and help protect it.

> THE OCEAN SUPPLIES MORE THAN HALF OF OUR OXYGEN, ABSORBS CARBON DIOXIDE, AND SUPPORTS MUCH OF THE WORLD'S ECONOMY.

We need more people to see the sea. Right now, less than 3 percent of the ocean is considered highly protected. Experts urge that at least 30 percent be protected to safeguard marine ecosystems, which in turn will help protect our health and well-being. The ocean supplies more than half our oxygen, absorbs carbon dioxide, regulates our climate, and supports much of the world's economy. We need it a lot more than it needs us.

Take Florida, for example, one of the United States' recreational hot spots. It's bordered by the Florida Reef Tract, North America's only living coral barrier reef and the third largest in the world. Home to more than 500 species of fish, the reef is also essential to the Sunshine State's economy, generating an estimated $1.1 billion annually in tourism. The reef buffers the coastline, too, since healthy coral reefs absorb 97 percent of a wave's energy. Three-quarters of Florida's 22 million people live along the coast, and the Florida Reef Tract provides more than $650 million in combined economic activity and flood protection.

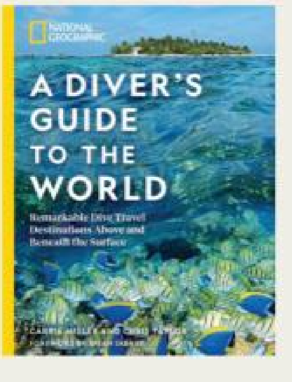
A November 2022 study from the University of Miami and NOAA's Atlantic Oceanographic and Meteorological Laboratory has found that 70 percent of Florida's coral reefs are experiencing a net loss of reef habitat. Squarely facing these concerns is what I mean by seeing the sea—the good, the bad, the important. Knowledge is power, and we can use it to inform our choices, from traveling more mindfully, to examining how we run our businesses, to voting. "No one can do everything, but everyone can do something," Sylvia Earle, oceanographer and National Geographic Explorer at Large, is fond of saying.

The ocean is a remarkable teacher, and it's never too late to start learning. ☐

Writer **Carrie Miller** and her husband, Chris Taylor, operate Beneath the Surface Media, a project that uses storytelling and dive travel to encourage conservation through exploration.

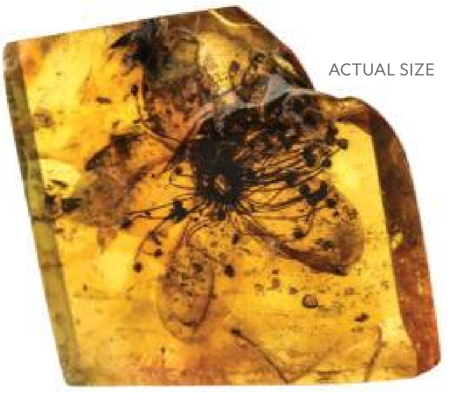
By Land and Sea

For *A Diver's Guide to the World: Remarkable Dive Travel Destinations Above and Beneath the Surface,* Carrie Miller and Chris Taylor traveled to 50 locations in 35 countries. The guide, which reveals extraordinary experiences and practical tips, is available wherever books are sold.



DISPATCHES FROM THE FRONT LINES OF SCIENCE AND INNOVATION

Prehistoric petals
This 1.1-inch-wide flower, 34 to 38 million years old and described in 1872, is the biggest amber fossil of its kind ever found. A new study of the bloom's pollen shows the plant is part of the genus *Symplocos*, which occurs today in Asia, Australia, and the Americas. —MICHAEL GRESHKO


ACTUAL SIZE



ADAPTATION

DISAPPEARING ACT

THESE SEE-THROUGH FROGS SLEEP SAFER FROM PREDATORS BY HIDING THEIR RED BLOOD CELLS.

With translucent skin and muscles, the glass frogs of Central and South America blend in with the green leaves they rest on during the day. But the camouflage is even more complicated than scientists realized, a study published in *Science* reveals. When Fleischmann's glass frogs *(Hyalinobatrachium fleischmanni)* sleep, they store up to 89 percent of their darkly colored red blood cells within crystal-covered livers. The crystals seem to act as a mirror, reflecting incoming light rather than allowing blood cells to absorb it. With their red blood cells stored away, the sleeping frogs become two to three times more transparent than the wakeful ones, by the study's measurements. Particularly intriguing: The *H. fleischmanni* frogs seem to suffer no ill effects from hours with those cells in one place—and still clot normally when wounded. Perhaps this could hold clues to what's been a holy grail of hematology: treatment that prevents excessive bleeding *and* excessive clotting in humans. "Blood clots kill around one in four people," says Jesse Delia, a National Geographic Explorer and study co-author. What if the secret to saving them is hiding inside a glass frog's discoball-like liver? —JASON BITTEL

SUSTAINABILITY

An oil that's better for the planet?

The world's most popular vegetable oil, palm oil is used in many food and household products. But making it damages Earth, as it's a major driver of deforestation in the tropics. An eco-friendly alternative is on the way: oil made from microbes. Scientists have identified scores of oil-rich algae and yeast strains that don't need space or sun to grow and could thrive on oxygen and sugar from other industries' waste. —SANDY ONG



PHOTOS (FROM TOP): CAROLA RADKE, MUSEUM FÜR NATURKUNDE BERLIN; NATURE PICTURE LIBRARY/ALAMY STOCK PHOTO; GRANT CORNETT (FOOD AND PROP STYLING: MAGGIE RUGGIERO; REBECCA BARTOSHESKY)



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INNOVATOR

CARTER CLINTON

BY **NINA STROCHLIC** PHOTOGRAPH BY **MARK THIESSEN**



This scientist analyzes African Americans' past to inform the present.

Not long ago, a line uttered on a reality TV show caught Carter Clinton's attention: "Life should be lived forward but understood backward."

Clinton, a postdoctoral geneticist at Pennsylvania State University, knew the concept from a very different setting: Manhattan's African Burial Ground National Monument. There, a granite memorial is etched with a heart-shaped symbol thought to carry that same meaning. Beneath it lie the remains of over 15,000 free and enslaved Africans from the 17th and 18th centuries.

For nearly a decade the National Geographic Explorer has studied grave sites to learn why African Americans disproportionately suffer from ailments such as cardiac disease and asthma. And the soil of this New York cemetery—the oldest and largest excavated site of its kind in the country—may still contain extractable DNA. Clinton hopes it will provide clues about the lives and deaths of these individuals, and by extension the ancestral roots of millions of African Americans alive today.

In the era of commercial DNA kits, people want not only to learn where their forebears are from but also to clarify their perceived identities, Clinton says. "We're ultimately putting the puzzles of ourselves back together. And African Americans are the community with the most missing pieces."

The National Geographic Society has funded Carter Clinton's work since 2017. Learn more about its support of Explorers at *natgeo.com/impact*.

LAST STOP ON THE LOVE TRAIN

EXPLAINING ECHIDNAS can strain the vocabulary. They're monotremes, or egg-laying mammals; they and the platypus are the only such creatures left on Earth. They come with long or short beaks—if by beak we mean a smooth tube of snout ending in a tiny, toothless mouth. And they're called spiny anteaters, but those aren't spines; they're rigid, modified hairs.

A baby echidna is a *puggle*. A group of echidnas is a *parade*—unless they're mature males waddling after a female in mating season, in which case it's a *train* (often with a younger male at the end, like a callow caboose). These love trains may grow to 10 or more males and may trail a female for days, until she signals the last stop by stretching out on the ground. Then males dig a rut in the earth around her and, sumo-wrestler style, try to shove each other out of the ring. The victor gets to mate with her first—and his male member looks purpose-built for that task.

The penile shaft has four heads, each plumbed to deliver semen—but only two heads are used in each erection, and the male alternates which two. That's possible because echidnas' erectile tissue anatomy differs from most other mammals', Australian scientists reported in a 2021 study. The anomaly likely helps males compete for mates: Swapping penis sides allowed one echidna to "ejaculate 10 times without significant pause," study authors noted.

About 20 days after mating, the female deposits one egg into her abdominal pouch. After 10 more days, her puggle hatches into the world. —PATRICIA EDMONDS



HABITAT/RANGE

Echidnas are found in New Guinea and all Australian states, from arid deserts to cold mountains. They don't settle in one nest but take shelter in brush piles, hollow logs, or dens they or other animals have dug.

OTHER FACTS

Adult echidnas can range from 14 to 30 inches long and weigh anywhere from five to 22 pounds. They're likely named after a mash-up from Greek myth: the monster Ekhidna, half reptile and half mammal.



PHOTO: DOUG GIMESY. NGM MAPS



The Alladale Wilderness Reserve is one of several places aiming to reintroduce plants and animals that once flourished in Scotland.

The Wild at Scotland's Heart



NATURE AND TRAVELERS BENEFIT AS REWILDING, A GROWING GLOBAL INITIATIVE TO RETURN NATIVE FLORA AND FAUNA, GAINS MOMENTUM IN THE SCOTTISH HIGHLANDS.

BY **MIKE MACEACHERAN**

PHOTOGRAPHS BY **ROBERT ORMEROD**

AT THE END OF THE LAST ICE AGE Scotland was a truly wild place, where the Highland tiger, a distinctly banded wildcat, as well as wolves, lynx, and bears, roamed among Caledonian pine forests. The Romans called the country's north the Great Wood of Caledon.

But over time, humans purged the Highlands for timber, charcoal, and agriculture. Native species such as wild boar, polecat, and elk vanished. Today only 4 percent of Scotland's land area is covered by forest.

Now an alliance of environmental groups and government agencies is pooling resources on a larger scale than ever before in an effort to rebuild Scottish ecosystems to their natural states. Some of the coalition's goals include committing a third of public land to nature restoration by 2030, expanding tree-planting projects, and reintroducing keystone species. If these initiatives succeed, they could make Scotland the first rewilded nation in the world.

"Scotland has majestic scenery and beautiful glens, but its ecology has long been greatly diminished," says Peter Cairns, executive director of the nonprofit Scotland: The Big Picture. "Climate breakdown is one of the principal drivers for rewilding gaining momentum because it unites everyone."

During the 1980s the approach to conservation tended to be selective, preserving individual species and specific habitats. Now the conversation has shifted, focusing instead on reigniting ecological processes with a landscape-scale approach.

Today rewilding is in action in more than 70 countries. Among the best known projects are the Peace Parks Foundation in southern Africa, co-founded by Nelson Mandela, and Rewilding Europe, which operates in places from Swedish Lapland to the southern Carpathians.

Key to Scotland's progress are both its utopian ambition and a collaborative approach toward habitat connectivity and species diversity.

In the Scottish Highlands, environmental charity Trees for Life is one of rewilding's main advocates. The group is nearly two years into a 30-year plan to transform Glens Cannich, Affric, Moriston, and Shiel—a succession of valleys in the central Highlands—into a vast nature recovery area known as the Affric Highlands. The project involves reviving damaged peatlands, restoring riverways and forests, and reconnecting wildlife corridors.

Visitors can get a preview of the ambitious project at the Dundreggan Rewilding Centre, opened this spring in Glen Moriston, on the site of a 14th-century royal hunting ground. The 10,000-acre campus offers walking trails, classrooms, Gaelic culture exhibitions, and—for researchers and volunteers looking for a fuller immersion—a 40-bed complex.

Travelers who head out into the reinvigorated Affric Highlands will find some of its 4,000 native plant and animal species, including roe deer, mountain hares, water voles, brown long-eared bats, otters, and black grouse. In 2020 golden eagles nested there for the first time since the 1980s.

Species resurgence is unfolding elsewhere, particularly at one of Scotland's most ambitious rewilding projects, Cairngorms Connect. Concentrated on a 148,000-acre subarctic plateau in Cairngorms National Park, the largest in Britain, the multi-landowner enterprise has embarked on a 200-year project to restore rivers and reseed the ancient Caledonian pine forest. This year around 20 wildcats will be introduced by the Royal Zoological Society of Scotland.

Rewilding has its critics. Opponents say prioritizing nature comes at the risk of alienating Highland communities and disrupting time-honored land management practices, such as farming, fishing, forestry, and hunting. And few farmers support the idea of free-roaming predators coexisting with livestock.



Nevertheless, there is a groundswell of public opinion in favor of transitioning to a wilder Scotland. Although the country's third national park has yet to be designated—an announcement is expected by 2026—the government has indicated that the park will be created for rewilding purposes, or nature restoration.

In a region where nature-based tourism contributes nearly 40 percent of visitor spending, according to government agency NatureScot, reintroduced species are already opening up new opportunities. The reestablished red kite can now be spotted along the Galloway Kite Trail on Loch Ken in Kirkcudbrightshire and at the Argaty rewilding farm in Perthshire. In the Moffat Hills, visitors can now spy golden eagles, thanks to the translocation of 30 raptors from the Highlands to southern Scotland.

Recently Eurasian beavers—wiped out 400 years ago—also have been reintroduced and translocated to sites such as the forests of Knapdale in Argyll and Bute. Elsewhere, on the River Tay, a canoe safari at sunset offers glimpses of these river dwellers when they are at their most industrious.

Meanwhile at the 23,000-acre Alladale Wilderness Reserve, in Sutherland, 50 miles north of Inverness, Paul Lister has sought to influence the shape of the Highlands landscape using his wealth and property. He set out in 2003 with a vision to reintroduce wild wolves, which were officially hunted to extinction in Scotland by 1680.

While that desire remains undiminished, he's successfully achieved other milestones, including the planting of a million native trees and the creation of a Highland wildcat breeding center.

"We now have healthy populations of red squirrel, badger, pine marten, ptarmigan, grouse, and trout," Lister says, "and it could only be a matter of years before the wolf joins them." ▯

Mike MacEacheran is a travel writer living in Edinburgh. **Robert Ormerod** is based in Scotland and previously photographed Florida's Space Coast for *National Geographic*.



Manager Innes MacNeil (at left) and ranger Ryan Munro plant trees along a riverbank in the valley of Glen More, on the Alladale Wilderness Reserve. The 23,000-acre former hunting estate hosts travelers who come to see rewilding in progress.



THAT GHOSTLY GLOW? IT COMES FROM A FUNGUS

PHOTOGRAPH BY **EVELYN PLAYER**

Hallucination? No. These mushrooms actually glow. Found in Australia's temperate forests after the autumn rains, the ghost fungus *(Omphalotus nidiformis)* gives off a soft radiance around the clock. With the naked eye, the luster is whitish blue; in a long-exposure photograph shot in darkness, it gleams eerie green. How might the ghost fungus benefit from being bioluminescent? That's still unknown.
—HICKS WOGAN



In a scene from *A Small Light,* Miep Gies (played by Bel Powley) leads Frank family friend Fritz Pfeffer (Noah Taylor) to the attic rooms where she helped the Franks and four other Jews hide from the Nazis.

AN UNLIKELY HERO

THE EXTRAORDINARY WOMAN WHO HID ANNE FRANK—AND SAVED HER JOURNALS—CONSIDERED HERSELF JUST AN ORDINARY PERSON.

BY **JACQUELINE CUTLER**

MIEP GIES WAS A recently married young office worker living in Amsterdam in 1942. As German occupiers tightened their grip on the city, Gies's boss, Otto Frank, asked her to hide him and his family from the Nazis, who were sending Jews to concentration camps. For the next two years, Gies risked her life daily to smuggle food to the Franks and four others concealed in secret rooms above Otto's business.

When she could no longer protect the family—when the Nazis finally came and took them away in 1944—Gies kept their story alive by saving Anne Frank's journals. She's the reason the world has *The Diary of a Young Girl*.

Later in Gies's life, people called her heroic. Believing she simply did what she could in evil times, she is said to have made this response: "Even an ordinary secretary or a housewife or a teenager can, within their own small ways, turn on a small light in a dark room."

A Small Light tells Gies's story in an eight-part miniseries shot in Amsterdam and Prague. In interviews on location, its creators and actors reflected on why Gies remains an inspiration.

"While most of us are familiar with the diary, what was going on outside the annex…is the mystery," says Tony Phelan, who with wife Joan Rater helmed the project. Rater adds to that idea: "What does hiding

PHOTO: DUŠAN MARTINČEK, NATIONAL GEOGRAPHIC FOR DISNEY



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people mean on a day-to-day basis? Miep said yes to Otto Frank, and then you have to say yes every day afterwards, even when it's hard, even when you're sick, even when you don't want to…And that, to me, the everyday drudgery of it all, is quite dramatic."

Phelan and Rater, married for 30 years, created, executive produced, and wrote the miniseries after six years of research. It was a 1995 documentary, *Anne Frank Remembered,* that initially sparked their interest, and they visited the Anne Frank House, the museum established where the Franks once hid. After descending its steep, narrow stairs—as Anne had—Rater noticed a girl doing cartwheels outside.

For *A Small Light,* Rater turned that memory of a girl's carefree spirit into a flashback scene: Anne in 1941, on Miep and Jan Gies's wedding day. She's skipping, giddy over the romantic city hall nuptials. Then, Anne was sassy and bridled at constraints; within a year, her life would be nothing but constraints.

One bright spot for Anne was visits from Gies, who ferried supplies by bicycle. Actress Bel Powley plays Gies and, to get into her character's mindset, retraced those journeys. "Tony and Joan gave me all these cool maps so that I could cycle Miep's route," she says.

Powley, who is Jewish, felt the weight of telling this story, especially as the shoot neared its end. Amsterdam's besieged streets, Otto's business, and the famous attic were re-created in Amsterdam and Prague.

Everything on-screen is rendered as accurately as possible. Period-specific costumes are intentionally threadbare, as they would have been during wartime. Although glamour might seem frivolous given the constant threat of death, the women in hiding "wanted to keep up appearances," hair and makeup designer Davina Lamont says. A dash of lipstick was an attempt at seeming normal, when nothing was.

On a raw day in Prague, 300 extras cheer GIs in a World War II tank rolling down a cobblestone street. The crowd waves orange flags, the Dutch royal color, for this scene depicting Liberation Day in May 1945. It came too late for the Franks: Anne had been arrested a few months earlier and died of typhus at Bergen-Belsen.

The girl who wanted to be a famous writer became one, of course. Her diary uniquely revealed the heart of a typical teen and the truth of the Holocaust, because readers who found the extermination of six million people unfathomable could relate to one girl.

Still, no one would ever read entries that began "Dear Kitty" had Gies not gathered the scattered papers and the diary with the red-checkered cover and later given them to Otto, the family's sole survivor. She did this "to be kind and compassionate," says Liev Schreiber, who portrays Otto.

Schreiber, whose Jewish grandfather emigrated from Ukraine, sees parallels between World War II's anti-Semitism and today's. He co-founded a humanitarian group that vets donations for NGOs in Ukraine, and while volunteering in that war-torn land, he met modern heroes risking their lives to help others.

In Schreiber's words, "The Miep Gieses of the world—the small lights, the extraordinary ordinary people who did something, who pushed back against tyranny, who pushed back against authoritarians, who pushed back against fascists—remembering what they accomplished, I think, gives us some perspective on what we can accomplish."

Journalist **Jacqueline Cutler** regularly covers television. She previously wrote about the National Geographic series *Limitless.*

The miniseries *A Small Light* premieres on National Geographic May 1 and Disney+ the next day. It airs in four two-episode blocks.







Historical photos, from left: Miep Gies, whose loyalty to her employer and fury at the Nazi genocide emboldened her to hide the Franks and others; the building, now known as Anne Frank House, where eight hid in the attic; and a May 1941 photo of (from left) Margot, Otto, Anne, and Edith Frank in Amsterdam, where they moved from Germany in 1933, after Hitler's rise to power.

PHOTOS: ANNE FRANK FRONDS, BASEL VIA GETTY IMAGES (GIES, THE FRANKS); SEPIA TIMES/UNIVERSAL IMAGES GROUP VIA GETTY IMAGES

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FEATURES



88

SLIME MOLDS, SUCH AS THIS *PHYSARUM LEUCOPHAEUM* ON A STRAND OF MOSS, THRIVE IN THE NOOKS AND CRANNIES OF DAMP PLACES AROUND THE PLANET, INCLUDING IN YOUR OWN BACKYARD.

FOCUS-STACKED IMAGE: ANDY SANDS, NPL

“THEY’RE ALL IN TROUBLE,” says Kenyan ecologist Paula Kahumbu. “All elephants are in major, major trouble.”

Populations of the three species have declined: savanna elephants, the largest land animals on the planet, trundling across sub-Saharan Africa; forest elephants, their straight-tusked cousins, navigating the shadows of Africa’s equatorial woodlands; and the smaller-eared Asian elephants, about a third of which live in captivity.

And we’re to blame. We’ve expanded into elephant territory, building homes and roads, felling forests and planting crops. More cruelly, people have indulged their desire for ivory trinkets that come from a dead elephant’s tusk. Although elephants are difficult to count, one estimate suggests that the African continent may have been home to some 26 million elephants at the beginning of the 19th century. That number has since plummeted, becoming dangerously low in the past five decades, with the rise of poaching. Now there are as few as 415,000 elephants in Africa. In Asia, there may likely be only 50,000 in the wild.

Poaching doesn’t just destroy animals, says Kahumbu, CEO of the Kenyan conservation



Elephants drink from a lake near Galgamuwa, in northwestern Sri Lanka. With much of the country’s land developed, its estimated 6,000 elephants are forced to share almost 70 percent of their habitat with humans.



WHERE THE ELEPHANTS ROAM

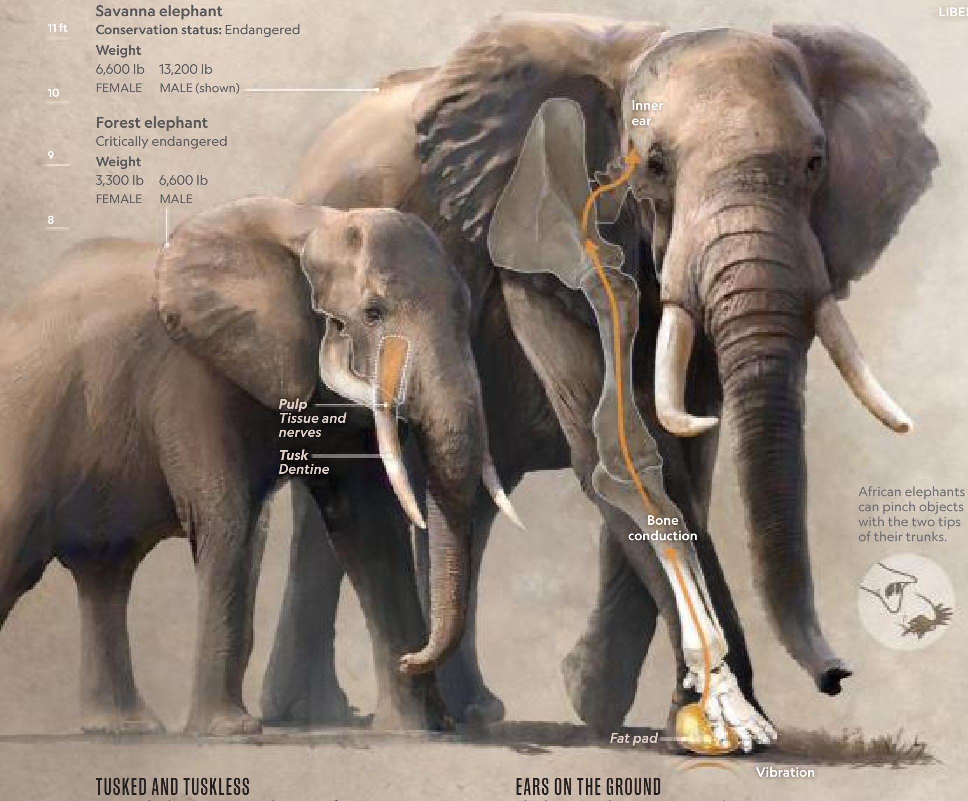
Like our distant human ancestors, woolly mammoths and other early elephants originated in Africa and spread toward Europe and Asia. On the way, they adapted to varying environments thanks to complex social structures, behaviors, communication styles, and brains. Three species remain—all adjusting to the challenges of living alongside people.

AFRICAN ELEPHANTS

Elephants once inhabited most of Africa. Today two species of the world's largest land animal roam sub-Saharan and West Africa.

Savanna elephant
Conservation status: Endangered
Weight
6,600 lb — FEMALE
13,200 lb — MALE (shown)

Forest elephant
Critically endangered
Weight
3,300 lb — FEMALE
6,600 lb — MALE



African elephants can pinch objects with the two tips of their trunks.

TUSKED AND TUSKLESS

Forest elephants navigate dense rainforests with straight tusks, which also allow them to dig for salt. Savanna elephants have curved tusks. Female Asian elephants are tuskless—and therefore not at risk for ivory poaching.

EARS ON THE GROUND

Elephants can hear varying vocalizations, from high-pitched trumpets to thunder-like rumbles that resonate from miles away. Receptors on their feet pick up vibrations, conducting sound to the inner ear.



HABITAT GENERALISTS
Elephants live in a variety of landscapes, from grasslands to wetlands to deserts, consuming hundreds of pounds of food daily.

FOREST GARDENERS
African forest elephants act as seed spreaders by dispersing seeds for miles in their dung after they eat fruit in the rainforests of West and Central Africa.

SURVIVAL IN THE SAND
Desert-dwelling savanna elephants hunt for water by digging holes in dry riverbeds with their powerful trunks, tusks, and feet.

HERD BEHAVIOR

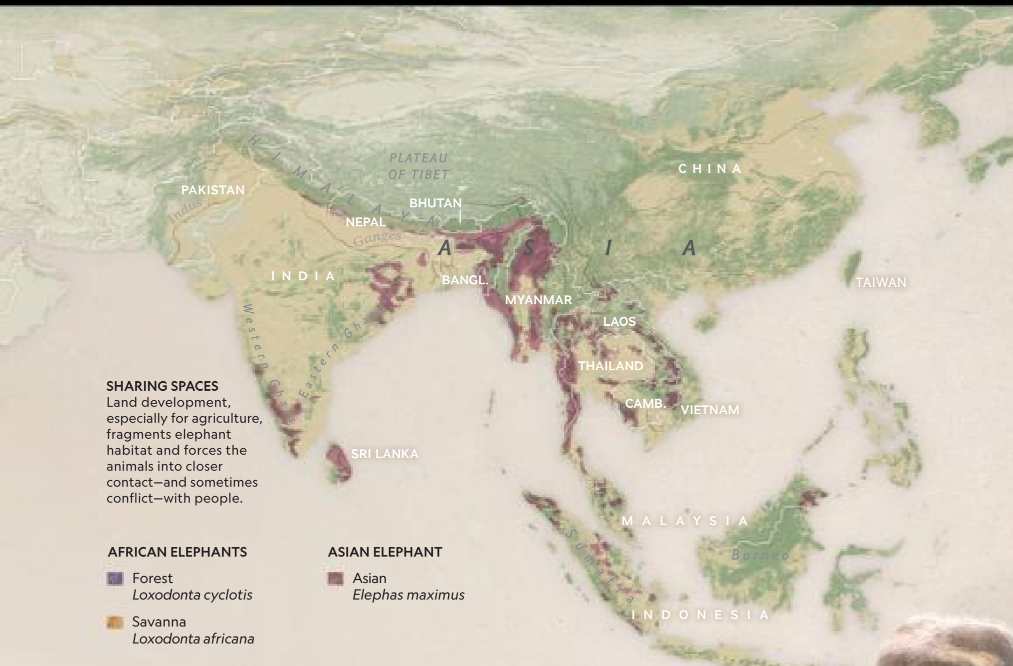
Elephant societies range from free-associating individuals to large female clans in a multi-tiered, matrilineal structure; groups can fuse or fissure over time. Males usually live alone or form groups. All three species have life spans of 60 to 70 years.



FREE-MOVING INDIVIDUALS

Recently recognized as a separate species, **African forest elephants** likely have individual-based societies. Each can freely socialize with kin and with unrelated peers.

CHRISTINE FELLENZ, MONICA SERRANO, PATRICIA HEALY, AND LUCAS PETRIN, NGM STAFF. MESA SCHUMACHER. ART: GAËLLE SEGUILLON. SOURCES: IUCN; ESA CLIMATE CHANGE INITIATIVE, LAND COVER DATABASE; PAULA KAHUMBU, WILDLIFEDIRECT; ALI NABAVIZADEH, UNIVERSITY OF PENNSYLVANIA; SANJEETA SHARMA POKHAREL, KYOTO UNIVERSITY, JAPAN; T.N.C. VIDYA, JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH, BENGALURU, INDIA; RAMAN SUKUMAR, INDIAN INSTITUTE OF SCIENCE; ASIER LARRAMENDI, EOFAUNA; SUZANA HERCULANO-HOUZEL, VANDERBILT UNIVERSITY



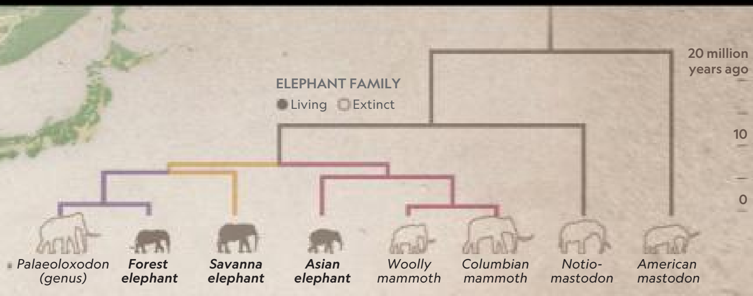
SHARING SPACES
Land development, especially for agriculture, fragments elephant habitat and forces the animals into closer contact—and sometimes conflict—with people.

AFRICAN ELEPHANTS
- Forest *Loxodonta cyclotis*
- Savanna *Loxodonta africana*

ASIAN ELEPHANT
- Asian *Elephas maximus*

LAND COVER
Barren · Shrubland · Cultivated and urban · Grassland · Forest

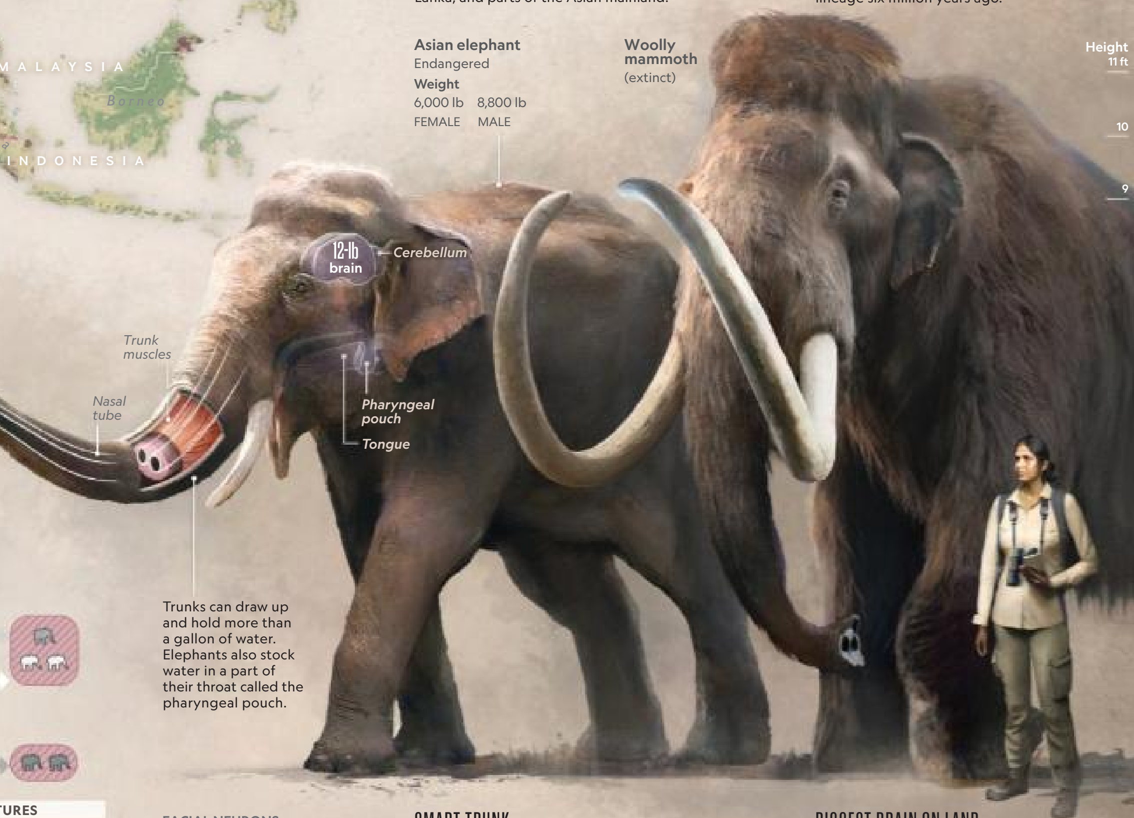
500 mi
500 km



ASIAN ELEPHANTS

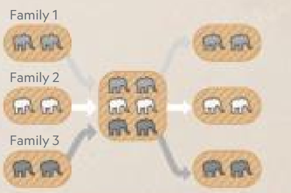
Their range once stretched to the Euphrates River. Populations are now found only on Borneo, Sumatra, Sri Lanka, and parts of the Asian mainland.

Mammoths that once ruled the high-latitude grasslands were more closely related to Asian than African elephants, which split from their lineage six million years ago.



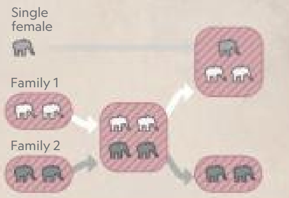
Asian elephants' single-tipped trunks grasp objects by wrapping around them.

Trunks can draw up and hold more than a gallon of water. Elephants also stock water in a part of their throat called the pharyngeal pouch.



STRICT FAMILY TIES

Savanna elephants begin with family groups, then extended kin, then clans. All converge in regional clan meet-ups where matriarchs determine which females will dominate, based on age.



FLEXIBLE SOCIAL STRUCTURES

Asian elephants are usually found in smaller herd sizes and have socially fluid associations. Individuals or families can socialize with others within their clans.

FACIAL NEURONS

Savanna e.	63,000
Asian e.	54,000
Human	9,000

SMART TRUNK

Elephants have six times as many facial nerve cells as humans, half of which control their complex trunk muscles. With this flexible appendage, the animals explore the world by touch and a hyperkeen sense of smell.

BIGGEST BRAIN ON LAND

Elephant brains are about three times the size of human brains, with triple the neurons, found mostly in the cerebellum. This relatively large part of the brain, one-fifth, allows for advanced sensorimotor abilities.

AVERAGE WEIGHT AND HEIGHT VALUES SHOWN

organization WildlifeDirect and a National Geographic Explorer; it undermines society. That's why her organization monitored poaching cases in Kenyan courts, launched a campaign called Hands Off Our Elephants with then Kenyan first lady Margaret Kenyatta, and educates children on the value of wildlife. Kahumbu's goal is lofty and urgent: to change "the whole national consciousness about conservation."

Now, she's taking her message to an international stage with *Secrets of the Elephants,* a four-part series on National Geographic and Disney+. It explores the hidden lives of elephants in four habitats—Asia, plus African forests, deserts, and savannas—as well as the people who are racing to save the animals.

One of those people is ethologist Joyce Poole, a leading expert on African elephant behavior. The National Geographic Explorer compiled five decades' worth of video and audio recordings of elephant communication—from ear waving to head butting—into the Elephant Ethogram, a publicly available digital library of elephant behavior.

As scientists learn more about elephants, they're developing more effective ways to protect them. Kahumbu points to elephant crossings that take advantage of the animals' geographic intelligence to negotiate major roads without hurting themselves or threatening nearby communities. "We kind of know what they need, but we aren't always generous enough," she says.

Secrets of the Elephants, she hopes, will familiarize people with the wildlife that lives in their midst. "As an African telling the story of Africa's elephants, I hope that it will get more Africans interested in elephants," she says.

While making the series, the plight of some elephants shocked her. "You look at their faces. They look so sad," she says. "They don't look well at all." She particularly noticed this in Asia, where Asian elephants and people live in increasingly close quarters. Despite decades of research into African elephants, much research into Asian elephants has lagged behind—which is why our feature in the following pages will focus on this species.

Yet Kahumbu also met people who were determined to save elephants. And therein lies one of her greatest aspirations for this series—that it "amplifies their work, their name, their voices, their achievements, so that we can start pouring support onto the places where good work is being done." **—RACHEL HARTIGAN**

Disney+

Watch *Secrets of the Elephants,* a four-part National Geographic series streaming on Disney+.



The National Geographic Society, committed to illuminating and protecting the wonder of our world, has funded Explorer Paula Kahumbu's work around wildlife since 2010 and Explorer Joyce Poole's storytelling since 1988.

ILLUSTRATIONS BY JOE MCKENDRY



BY **SRINATH PERUR**

PHOTOGRAPHS BY **BRENT STIRTON**

E
EPHANT
XT
OR



A male elephant steps over an electric fence on a moonlit night at the edge of Sri Lanka's Kaudulla National Park. The island's nearly 3,000 miles of electric fencing isn't foolproof: Elephants often examine wires with their trunks or push trees onto fences and then step between the fallen wires.

THESE ADAPTABLE ANIMALS ARE LEARNING TO LIVE WITH US—BUT WILL WE LEARN TO LIVE WITH THEM?



Beloved religious symbols in many Asian cultures, elephants are the highlight of the annual Dasara festival procession in Mysuru, India. They're also icons of power long associated with royalty and known for their service in wartime and as beasts of burden.





Elephants wander a tea estate in Valparai, India, which was part of their forest habitat before being converted for production in the late 1800s. Today about 70,000 people live and work in the region among 120 elephants.



Young elephants in India's Bandipur National Park throw dirt on themselves. This is a behavior they observed from their mothers to protect their skin from sun and insects.



A

AS WE SQUELCH through the wet mud, Nisar Ahmed M.K. suddenly motions to crouch low. The surrounding foliage, washed vibrant green by a recent rain, has opened onto a pond, where a few young elephants splash about, tumbling over each other. The rest of the herd of about 20 elephants watches nearby in this coffee plantation in Hassan, a district in southern India.

Behind us are the plantation quarters, simple structures with red-tiled roofs, whose residents often cross paths with these multi-ton pachyderms. From 2021 to 2022, elephants killed 12 people in Hassan, population 1.8 million. In the same period four elephants died, among which one was shot, one electrocuted, and another run over by a train. Most of the 65 or so elephants in the region bear bumps believed to be from gunshot wounds, Nisar says. It's an uneasy coexistence.

That's why Nisar—a field coordinator with the Nature Conservation Foundation, a nonprofit based a few hours away in Mysuru—and colleagues operate an early-warning system to help people stay out of the elephants' way. When the animals are known to be in an area, signs at road junctions announce their presence, beacons light



The National Geographic Society, committed to illuminating and protecting the wonder of our world, has funded Explorer Brent Stirton's work around wildlife since 2016.

ILLUSTRATION BY JOE MCKENDRY



up, and residents receive text and voice messages on their phones. But, as with any exercise involving humans, it's not always that simple.

Earlier that day, as Nisar drives his jeep slowly along a dirt road, looking for a radio-collared animal's location, he spots a bright huddle of umbrellas and raincoats: people unaware that only a few rows of robusta coffee plants separate them from elephants.

He curses and stops to pick up a woman and three children in school uniforms. She acknowledges she got a message warning about the nearby elephants, but the kids had to be picked up from school, and she didn't have access to a vehicle. I ask one of the children, a 10-year-old girl, if she has seen elephants. She looks at me like I'm daft—just this morning she saw a gathering of 13 outside her house. Does that scare her? "It does," she says, but then grins and shrugs, as if to say, This is just how things are.

Such is the reality in parts of India, Sri Lanka, and Southeast Asia, where elephants and people jostle for space in an increasingly human-dominated landscape. Once, these highly social animals ranged across Asia, including China and as far west as the Euphrates River. Now an endangered species, Asian elephants hang on in only about 5 percent of their historic range. Expanding cities and infrastructure have fragmented habitats, and invasive plants that crowd out their usual food sources may pose a further threat. While precise numbers are hard to arrive at,





At Mysuru Palace, elephants touch trunks, perhaps a gesture of comfort. Festivals can be stressful for the pachyderms; the day before, these animals were among large crowds of people at the Dasara celebration.



Near the Kahalla-Pallekele nature reserve in Sri Lanka, a female elephant touches a calf with her trunk while leading a group of young to water. Elephants take years to mature, all while observing adult behavior. Some juveniles help care for younger calves.



Upul Chataranga, 28, spends many nights a year in a lookout, guarding crops from elephants near Galgamuwa, Sri Lanka. When the animals approach, he begins shouting and lighting firecrackers, but this can make the animals more aggressive.



AN EARLY-WARNING SYSTEM HELPS PEOPLE STAY OUT OF THE ELEPHANTS' WAY, WITH ROAD SIGNS, BEACONS—AND TEXT AND VOICE MESSAGES ON RESIDENTS' PHONES.

there may be fewer than 50,000 wild Asian elephants left, including 30,000 in India. Researchers and conservationists agree that if the species is to survive, people and elephants need to get along. And there's still a long way to go. From 2020 to 2022, people in Sri Lanka killed more than 1,100 elephants, and nearly 400 people died in elephant encounters. In India, from 2018 to 2020, 300 elephants and 1,400 people died because of human-elephant conflict, a phenomenon that occurs when habitat loss forces both species into close contact, often leading to injuries or death.



Living peacefully with such an intelligent and adaptable animal requires a thorough understanding of its social structures. While there exists a long-standing body of knowledge, the Asian elephant has been far less studied by scientists than the African elephant—especially in the wild. So over the past two decades, a dedicated group of researchers has been filling in these gaps, revealing an animal that's different from its African counterpart.

One of those people is Prithiviraj Fernando, who has been studying the species for more than 30 years, particularly in Sri Lanka, where the country's estimated 6,000 elephants share almost 70 percent of their habitat with humans. Many of the island's large reservoirs release water in the dry season, creating lush grasslands that attract the behemoths. "Asian elephants are an edge species," Fernando says. They do very well just outside forest boundaries.

It's a sunny, breezy September afternoon in Kaudulla National Park in north-central Sri Lanka, a protected area around the Kaudulla reservoir. The water level has receded, leaving a large plain of fresh grass where 23 elephants are busy feeding. Jennifer Pastorini, who runs the nonprofit Centre for Conservation and Research with her husband, Fernando, takes copious photographs and videos of the herd. They provide data on body condition, including injuries incurred during run-ins with people or other elephants, and allow for observations about the animals' relationships with each other.

Social interactions are challenging to study in Asian elephants. For one thing, it's difficult to consistently observe the animals in forests or scrublands. And when they can be seen together in the same place, Pastorini says, "they mostly ignore each other." For most of the afternoon in Kaudulla, the elephants are focused on food, ambling around one another in the grassland, tails swaying, ears flapping. Asian elephants spend around 16 hours a day eating grasses, leaves, and bark. This kind of prodigious diet—hundreds of pounds a day—requires a large area, which is why an Asian elephant can have a home range of hundreds of square miles.

Near dusk, an adult female and a calf begin walking across the grassland in a more or less straight line toward us. In their path is a cluster of three adult females and two calves. As the pair draws closer to the group, Pastorini says, "Let's see if there's also an interaction." There is, as they huddle and reach out to each other with their trunks, in what could be a bonding gesture.

For a long time, scientists assumed Asian elephants had social structures similar to those of African savanna elephants. This was certainly true on the surface: Both these long-lived species gather in herds of related adult females and calves, with males leaving the group during adolescence, when they're eight to 13 years old. But perhaps the best known aspect of African savanna elephant society—that the oldest female, the matriarch, is the most dominant—does not appear to be the case with Asian elephants. Instead, Asian elephants live in smaller, less hierarchical, and more loosely collected groups that can separate and reunite


FILA



Bendiwewa villagers in Sri Lanka erect a section of solar-powered electric fencing. The 2.2-mile-long fence aims to protect 90 families' gardens from routine elephant incursions.



Mahout J.S. Raju leads a blind elephant, Ekadanta (Sanskrit for "single tusked"), to be bathed at Harangi Elephant Camp in Karnataka state, India. Retired from tourism, Ekadanta is likely over 60. Some researchers are turning to experienced mahouts as repositories of knowledge about elephant behavior and management.



over time. Smaller groups will also sometimes associate with wider clans involving more distantly related animals.

"The group composition keeps changing," says Pastorini. "Today we see these 20 together. Tomorrow 10 of them might be over there and the other 10 over there. It's very flexible."

Not only that, but Asian elephants, especially young animals, are very flexible, says Nishant Srinivasaiah, who heads the Frontier Elephant Programme in Bengaluru, India. For his Ph.D., Srinivasaiah studied male elephants living on the outskirts of Bengaluru, the capital of Karnataka state. He found large, stable all-male groups of up to 25 individuals, something never seen before in the area. Male elephants in protected forests are usually observed alone, in small groups of three to four males, or temporarily attached to a group of females and calves. These young males were sticking together—and often seeking the company of experienced older elephants—to better navigate a challenging world of highways, fences, railway tracks, and electric wires.

Over the past few decades, these bull groups have also adopted what he calls a high-risk, high-gain feeding strategy: chancing potentially deadly interactions with people to feed on crops, a quick food source that boosts their health and physical condition, a bonus when looking for a mate. These crop-raiding males come from the same population as forest-dwelling elephants that spend time alone or in small groups and are passing these practices on to new generations. "What we are witnessing here is cultural evolution," Srinivasaiah says.

As scientists learn more about Asian elephants, they're discovering an animal that shares many cognitive abilities with people and other apes.

In 2005, Joshua Plotnik, who now leads the Comparative Cognition for Conservation Lab at Hunter College in New York City, was part of a team that administered the mirror self-recognition test to Happy, an Asian elephant at the Bronx Zoo. The test determines if an animal knows that it's seeing itself in a mirror, and not another animal. Happy passed, adding Asian elephants to an exclusive list of species, including dolphins and chimpanzees. This advanced ability is partly why the U.S. nonprofit Nonhuman Rights Project petitioned a New York State trial court to grant Happy personhood and move her from the isolation of the zoo to a sanctuary. The petition worked its way to the state's highest court, the New York Court of Appeals. In 2022, the court ruled against the nonprofit, five to two.



Since the mirror test, Plotnik and colleagues have established that captive Asian elephants may recognize when their own body is an obstacle to completing a task: In experiments, the animals will get off a mat and drag it by an attached stick to a researcher, something human children can typically do when they're well into their second year. That ability, combined with the mirror test, points to "a keen sense of self-awareness," Plotnik says. Such research has not yet been published on African elephants.

Around 10 years ago, Plotnik attended a meeting in Thailand, where he was struck by villagers



Elephants interact with a steel puzzle box on a hill overlooking the junction of Thailand, Laos, and Myanmar. Many of the wild elephants tested can solve the puzzle by trying different ways to open the box's doors, showing their ability to innovate, according to experiments by researchers at Hunter College in New York City.

LIVING PEACEFULLY WITH SUCH AN INTELLIGENT ANIMAL REQUIRES UNDERSTANDING SOCIAL STRUCTURES. ASIAN ELEPHANTS ARE LESS STUDIED THAN AFRICAN ELEPHANTS.

talking about elephants turning on water faucets or finding ways around fences. This inspired him to extend his work on sensory and cognitive abilities of captive elephants to wild elephants in Thailand. "If you're going to develop ways of trying to help elephants and humans coexist, you need to consider both how humans think and the way elephants think," he says.

In Thailand's northernmost province, Chiang Rai, at the border of Laos and Myanmar, Plotnik and his team demonstrate their wild elephant research with the help of a captive 31-year-old



A group of male elephants feeds at a dump near Dambulla, Sri Lanka. The animals are drawn to nutrient-rich organic waste from the town's markets. Many elephants, alerted by the sounds of vehicles, arrive at dumps just as garbage is being unloaded.



Sumith Ranatunga, 44, was lucky to survive after being knocked off his motorcycle and trampled by an elephant in Galgamuwa in 2022. Still, he bears no ill will toward the animals, saying, "If we could return the forests to the way they were, we would not have this problem. It is we who have taken from the elephants."



'TO HELP ELEPHANTS AND HUMANS COEXIST, YOU NEED TO CONSIDER BOTH HOW HUMANS THINK AND THE WAY ELEPHANTS THINK.'

—Joshua Plotnik, Hunter College

female elephant named Ja Thong. She walks up to three steel boxes fastened to a tree. The muggy air is redolent with the sweet, heady smell of jackfruit, a chunk of which is in each box. The boxes are a kind of puzzle that tests an elephant's ability to problem solve.

Getting to the treats inside requires pushing the door of one of the boxes, sliding aside another, and pulling a chain on the third. Ja Thong feels about the boxes with her trunk and her mouth. When the push door falls open after a couple of minutes, it looks somewhat



accidental. The sliding door takes her two more minutes, but the chain pulling proves harder. Ja Thong seems exasperated, thumping her trunk on the ground and making a sound like a tire bouncing. Her mahout cheers her on, shouting instructions, and in about 10 minutes all three doors keeping her from the jackfruit have been opened. When Ja Thong tries again, she's faster, quickly solving all three puzzles.

One of the key factors that determine whether an elephant solves the puzzle boxes is persistence, says Sarah Jacobson, a Ph.D. candidate at Plotnik's lab who's studying innovative problem-solving in wild elephants in Thailand. Jacobson's preliminary results from camera traps placed in Salakpra Wildlife Sanctuary, in western Thailand, show that over half the wild elephants that approached the puzzle box decided to interact with it. Of those, more than half could solve at least one of the boxes, and about a tenth could solve all three. This shows a variability in the elephants' willingness to try something new, as well as their aptitude for working through a challenge.

Over lunch at a roadside café, Jacobson reviews footage, including one video in which a male elephant with a wounded ear calmly opens all three boxes almost instantly. But another clip from the same forest shows a male extending his trunk but not quite touching the boxes. His tail goes stiff, and his ears flare out. "So that's like a high-alert behavior," Jacobson says, watching the elephant move away.

Indeed, elephants have unique personalities that Plotnik and his team are studying with a view toward decreasing conflict with humans. Some Salakpra elephants routinely emerge from the forest to dig up cassava crops. For instance, if a certain elephant is known to be particularly innovative—say, that male with the injured ear—perhaps sounds or flashing lights might discourage him more than a fence.

At a large, bright lab at the Indian Institute of Science in Bengaluru, biologist Sanjeeta Sharma Pokharel shows me glass vials containing what looks like dry earth. It's actually elephant dung.

They may not look like much, but these fecal samples can reveal the amount of stress hormones in an elephant at a given time. Previous research has shown that prolonged stress may cause a host of negative impacts on the health of animals and their ability to reproduce.

"I wanted to study what is happening within the elephant," says Pokharel. She spent much of her Ph.D. research lurking in bushes near elephants or following them through fields and plantations. This allowed her to collect fresh droppings from two habitats in southern India: protected areas and Hassan, where elephants live amid human cultivation. She expected that elephants that fed on crops would show higher levels of stress because of the risks inherent in dealing with people. What she found was surprisingly the opposite: Elephants that fed on crops had lower stress levels than did the protected forest–dwelling elephants. Analysis of their dung showed that a diet of crops was richer in protein. Perhaps, Pokharel hypothesizes, a better-quality crop diet outweighs its risks and,



An elephant towers over two women on its way to a festival in Kerala, India. These gatherings can be traumatic and painful for elephants if they're chained, mistreated, and forced to perform tricks. Walking on hot roads can also harm their sensitive feet. Both elephants and people die in conflicts sparked by close interaction. Preventing such deaths motivates researchers to learn as much as they can about Asian elephants and how to coexist with them.


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57
Scooty
Pep+



An older male elephant in Yala National Park in coastal Sri Lanka is known for taking night-time walks on the beach. People who work with elephants often attribute distinctive personalities to them.



as her study says, acts as a pacifier against stress.

In 2022, Pokharel and Nachiketha Sharma, both currently postdoctoral fellows at Japan's Kyoto University, published research that studied how Asian elephants behave around dead and dying elephants. They analyzed videos of adult females, presumably mothers, carrying around calf carcasses—something they never do with living calves—and elephants gathered next to a carcass, touching each other with their trunks in what looked a lot like reassurance. Pokharel and Sharma feel that elephants do experience grief, but more evidence is needed to say so with scientific rigor. They changed the illustrations of elephants in their paper after one of the reviewers raised the concern that they might have humanlike expressions. "A little anthropomorphism may not be a bad thing," Sharma says, "if it helps people care for elephants."

The elephant's role in religion has also rooted it squarely in Asian societies. Buddhists believe the Buddha was once incarnated as a six-tusked white elephant, and Hindus worship an elephant-headed deity named Ganesha. Many temples in southern India, Sri Lanka, and parts of Southeast Asia own elephants. At the Dasara festival, a dozen decorated elephants parade down the streets of Mysuru, with one of them carrying an idol of the Hindu deity Chamundeshwari. At the festival of Esala Perahera in Kandy, Sri Lanka, around a hundred elephants covered in robes, ornaments, and even electric lights accompany a replica of a golden casket containing a sacred tooth relic of the Buddha. But such events can be traumatic and stressful for the animals; many have been abused for years. When not forced to perform, the elephants are often kept chained in small spaces.

BUDDHISTS BELIEVE THE BUDDHA WAS ONCE INCARNATED AS A WHITE ELEPHANT, AND HINDUS WORSHIP AN ELEPHANT-HEADED DEITY NAMED GANESHA.

People and elephants in Asia have a long, intertwined history. Seals from the Harappa civilization, over 4,000 years old, depict tamed elephants. With the advent of kingdoms and republics in India in the first millennium B.C., the elephant became prominent as an animal of war—used as a fighting platform and to charge enemy ranks—and remained so until a few hundred years ago, says Raman Sukumar, national science chair and honorary professor at the Indian Institute of Science. After they stopped being used for war, the animals remained mainstays for activities such as transporting goods and logging.

Sukumar speculates that there wasn't commensurate captivity of African elephants, in part because North Africa, where early kingdoms arose, did not have the elephant populations required to sustain equivalent long-term use in war.

Reverence can quickly sour when livelihoods and property are at stake. Confrontational methods for deterring wild elephants, such as using firecrackers or guns, simply do not work, Fernando says—they can both harm elephants and make them more aggressive. The only thing that works, he says, is the electric fence.

"Coexistence does not mean you have an elephant in your garden," says Fernando; it's more of a "fine-scale separation." That's why his organization advocates the carefully planned use of two kinds of often solar-powered electric fences: the village fence and the seasonal fence, both of which are equipped with a pulsed current that jolts an elephant without injuring it. A village fence encloses a human settlement, keeping elephants out of homes and gardens. A seasonal fence is temporary, erected only when a crop needs protection from elephants, leaving the

area free for use by elephants at other times. The Centre for Conservation and Research provides the materials and guidance for putting up the fences and expects villagers to supply labor and contribute to maintaining them. That way, Fernando says, people feel ownership of the fences.

Yet in an arms race of sorts, the animals are constantly testing their boundaries: using their trunks to investigate electrified wires or pushing trees onto fences and then stepping between the fallen wires. Fernando realized that fences need to be erected close to people, so that elephants are too wary to experiment with disabling them.

Fernando recently traveled to the village of Sathsurugama, in southern Sri Lanka, to inspect the hanging fence his organization has helped install around the village perimeter: Relatively advanced, it consists of a loose curtain of wires that hang vertically from a cross wire 13 feet high, making it difficult for elephants to bring it down. A neighboring village initially refused the fence, believing it to be ineffective, but now, Fernando says, having seen it work in Sathsurugama, those villagers have asked for one too.

Electric fences are "a workable model" to address conflict, says Sumith Pilapitiya, who chairs a Sri Lankan presidential committee working to reduce human-elephant conflict. This year the government is incorporating the fencing approach developed by the Centre for Conservation and Research into mitigation efforts in three Sri Lankan districts with high levels of conflict.

About 30 miles from Bengaluru, near a town called Ramanagara, elephants are moving to human-dominated areas by choice as improved irrigation practices yield crops year-round. Srinivasaiah, who studied those all-male herds, and his team are working with the government and local villages to install electric fencing in the region before more elephants arrive—"not to prevent them, but to build the capacities of the people." The idea, he says, is to change the public discourse from "Your elephant is in my village. Do something!" to "My elephant is in my village. What can I do about it?" His Frontier Elephant Programme also provides support for community-driven fencing, with some tweaks. When the scientists noticed elephants testing their fences, they planted a narrow belt of crops outside the fence—essentially, an offering of free food. It seems to work, Srinivasaiah says: No fences have been breached so far.

That early-warning system deployed in Hassan has also shown success in other locations, including Valparai, where it originated. In this rolling, 85-square-mile plateau of tea plantations in the south Indian state of Tamil Nadu, about 70,000 people live and work alongside elephants, 120 of which may pass through the area, especially in the winter months. In 2002, plantation companies, which were losing an average of three people each year to conflict with elephants, asked M. Ananda Kumar, now senior scientist at the Nature Conservation Foundation, to step in. Kumar and colleagues developed the community-driven system in Valparai, to monitor the plateau's elephants and then send targeted alerts by text messages, voice calls, and remotely operated beacons to plantation workers. Though the animals continue to damage property, human deaths have fallen to an average of one a year, with no deaths in the past two years.

What's the future for the Asian elephant? Sukumar believes that a mix of climatic and human-made factors will force the species into more isolated pockets. In the long term, he says, this could lead to elephants becoming smaller, a phenomenon that has already occurred in the elephant populations in Borneo, which are 30 percent smaller than their relatives. Sukumar points out that larger species of elephants that lived in Asia in past millennia have already gone extinct.

For the time being, people's reverence for elephants somewhat moderates the tension between the two, says M.D. Madhusudan, an independent conservation researcher and visiting scientist at the National Centre for Biological Sciences, in Bengaluru.

"Even where there's a lack of physical space, there's an enormous cultural space," he says.

I think of this near Mattala, in southern Sri Lanka, when a herd of about 30 elephants crosses a highway. First, the elephants bide their time in the shrubs until there is a lull in traffic. Then the few vehicles on the road wait as the animals deftly step over the barricades, the smallest in the herd struggling to keep up. They have reached the other side and resumed feeding when a passing car stops. The window rolls down, and a little boy thrusts his head out, his face lit up with awe and delight. He shouts out the Sinhala word for elephants: *"Aliyo!"* ▯

Srinath Perur is a writer and translator based in Bengaluru and Dharamshala, India. **Brent Stirton** covers wildlife, global health, and the environment.

BY **SUZETTE BREWER** • PHOTOGRAPHS BY **DANIELLA ZALCMAN**





FORCIBLY REMOVED

For centuries, Indigenous children were taken from their families and placed in missions and boarding schools. For former students like those in these portraits, the reckoning has just begun.

WANDA GARNIER, LAKOTA

Sent to Holy Rosary Mission, South Dakota, 1958-1963

"They took the home life away from us," says Garnier, who misses her family's former closeness. "Before Holy Rosary, I just loved that connection we had. We were everything ... But after Holy Rosary, that all went away. Families got separated, where to this day a lot of people don't even know who they're related to, you know? So our culture was totally, totally messed up in boarding school."





PATRICIA WHITEFOOT doesn't remember everything from her time at the Yakima Indian Christian Mission, a boarding school on the Yakama Indian Reservation in Washington State.

"I do remember the runaways," says Whitefoot, who says she was five or six at the time. "I would witness the older girls running away, and we all had to keep a secret as the girls prepared to run away from the mission. And we did."

Whitefoot, now 73, also remembers missionaries showing up at her grandparents' house on the reservation. Soon afterward she found herself in a dormitory with other Native girls. For the next few years, her life consisted of rules, farmwork, and little affection from the adults in charge.

What she can't forget is the cloud of otherness, fear, and control that permeated her childhood.

"I was raised by my maternal grandparents, who were very loving and nurturing and compassionate," says Whitefoot, a citizen of the Yakama Nation with ancestry from Taidnapam, Klickitat, Skiin, Spokane, and Diné (Navajo). "But I began to realize that there was something amiss."

Her grandmother had "outbursts," which jolted Whitefoot and her sisters. They did not understand where her anger was coming from.

"Then my grandmother began to talk to me about it," says Whitefoot.

She slowly realized that her grandmother was struggling with severe trauma from her time at the Fort Simcoe Indian Boarding School in White Swan, Washington. Like similar schools across the United States and Canada, Fort Simcoe had a mission: Educate and Christianize Native children to assimilate them fully into the dominant culture's way of life.

But as evidence gathered over the past few



The National Geographic Society, committed to illuminating and protecting the wonder of our world, has funded Explorer Daniella Zalcman's photography about the human experience since 2018. For this project, her double-exposure portraits overlay images of boarding school survivors with sites and memories connected to their childhood experiences of trauma and cultural loss at the schools.

ILLUSTRATION BY JOE MCKENDRY



EUGENE HERROD, MUSCOGEE

(Previous photo)

Carter Seminary, Oklahoma, 1956-1968

"Corporal punishment was rampant," says Herrod, who was only six when he was sent to boarding school. It wasn't uncommon for children to be told to drop their pants and underwear to get hit "*wham* [with] big boards." But for him, physical pain was nothing compared to the loneliness. "It was the emotional isolation that I remember being the hardest," says Herrod. "The familial dysfunction that was occurring in our communities and in our families was a result of this government totally obliterating a really well-conceived and well-built tribal society that had lasted and endured for centuries."



VIOLA GALA, HUALAPAI (Left)

Theodore Roosevelt Indian Boarding School, Arizona, 1964-68; Phoenix Indian School, Arizona, 1968-1970; Stewart Indian School, Nevada, 1972-73

Gala made good grades but was beaten when she spoke Hualapai. When her mother was hospitalized, "I didn't even know if she was going to die," says Gala, whose tribal homeland lies along the Grand Canyon's western rim, far from the boarding schools she attended in Fort Apache, urban Phoenix, and northern Nevada. "My brothers were thinking the same thing too. They didn't tell us anything. My brothers came, and they asked if I wanted to go see my mom. So we left at 7 p.m. that night to try to see her. Not even an hour later we heard policemen arrive to take us back."

GEORGE JOHNSON, YUP'IK (Above)

Wrangell Institute, Alaska, 1963-64
Chemawa Indian Training School, Oregon, 1967-1971

The worst part of boarding school life was listening to other kids crying from homesickness at night, says Johnson. But he felt the same about his life in Alaska. "I missed a lot of hunting. That's what I missed. Going places like fishing, hunting with my brothers." He also missed the freedom to pick blueberries and look for clams. Living so far from home for so long meant forgetting skills his family had taught him, he says. "You go out there and stay out so long in the lower 48, you come home and you say, 'How do you do this?' ... You stay away from home so long, you don't know how to cook."

decades reveals, hundreds of thousands of American Indian, Alaska Native, Canadian First Nations, and Native Hawaiian children were forced to attend these schools that typically had little to do with education or Christianity. For many Native peoples, the schools were ongoing nightmares of reprogramming, abuse, child labor, and torture that continue to haunt Native families and communities to this day.

FROM THE MOMENT Columbus dropped anchor off the shores of the Bahamas in the late 15th century, Native children became prize pawns in the battle for the subjugation and domination of the Western Hemisphere. European missionaries, operating under papal bulls that outlined the Doctrine of Discovery, began distancing Native children from their parents by establishing mission schools in which the kids were little more than unpaid laborers.

In the mission system, "education" was code for Catholic conversion. Native children were de facto hostages who endured slavery, forced labor, debt peonage, violence, and sexual abuse. "Ecclesiastical slavery" is how a British merchant described it after visiting the California missions. These brutal human rights abuses, perpetrated by the Roman Catholic Church, went on for centuries.

The U.S. government continued the use of education as a tool for subjugating Indigenous peoples. The Indian Civilization Fund Act of 1819 funneled federal money to Protestant and Catholic churches to found boarding schools "for introducing among [the Indian tribes] the habits and arts of civilization." In practice, that meant cultural eradication and forced religious conversion. This policy led to the eventual creation of government-run boarding schools, beginning in 1879 with the Carlisle Indian Industrial School, founded by Richard Pratt, an Army officer whose experiments in assimilation with Native prisoners became the blueprint for "Indian education." His stated mission: "Kill the Indian in him, and save the man."

Native children as young as four were forcibly rounded up. Parents who resisted were imprisoned and denied food rations on the reservations as punishment. In 1886, Mescalero and Jicarilla Apache refused to hand over their children to U.S. Indian agent Fletcher Cowart. "The Indian police," he reported, "had to chase and capture them like so many wild rabbits."

When children arrived at the schools, their long hair and braids were cut and their traditional clothes taken away. Forbidden from speaking their languages or practicing their spiritual beliefs, the children often lived in overcrowded dorms amid unsanitary conditions: Diseases such as tuberculosis and measles were rife, nutrition poor, and medical care inadequate.

They were routinely subjected to physical, psychological, and sexual abuse by the same people who had been charged with protecting them. Runaways from schools were chased down by professional trackers and brought back to face severe punishments, including rape by their bounty hunters, for attempting to escape. In 1930 Congress held hearings about accusations that staff at the Phoenix Indian School in Arizona flogged a student to death and whipped "some 80 little boys who ran out of bounds to see a merry-go-round," among other brutalities.

"We weren't human to the missionaries, and you could see it in the way they stared at you," says Whitefoot. "That's one of the things I do remember: that stare."

Some students died from disease or suicide. Others perished under mysterious circumstances—buried without death certificates and interred in unmarked graves, their families given little information about what had happened to their children. In Canada, 4,127 First Nations children are known to have died in residential school custody, though the Canadian government stopped recording deaths in 1920. The top official at the country's Truth and Reconciliation Commission speculated the true figure "could be in the 15,000 to 25,000 range, and maybe even more." Since 2021, more than 1,700 potential unmarked graves have been located in Canada.

That same year, Secretary of the Interior Deb Haaland, a member of the Pueblo of Laguna, New Mexico, launched the Federal Indian Boarding School Initiative to "undertake an investigation of the loss of human life and the lasting consequences of the Federal Indian boarding school system." More than 500 deaths have been identified, though the Department of the Interior has warned that these numbers could grow to tens of thousands as the investigation unfolds.

FOR ALL THE SORROW and trauma, students often had nothing tangible to show for their so-called education. Many worked long hours as low-paid or even free labor for local families and businesses. Though more than 100,000



PAINFUL LESSONS

Some 500 federally funded boarding schools for Native children were opened in the U.S. and Canada beginning in the 1800s. Most focused on religious conversion, often through forced manual labor and brutal punishment. In some cases, children were sent thousands of miles from home.

Native children are estimated to have attended these schools in the U.S., educational outcomes were abysmal. At Carlisle, for example, only a few hundred students of the many thousands who were enrolled during the school's 39-year history received high school diplomas.

Meanwhile, Native schoolchildren were cut off from what their cultures could teach them. "We get tagged with the myth of the hunter-gatherer, but that was hardly the case," says Kevin Gover, the undersecretary for museums and culture at the Smithsonian Institution and a citizen of the Pawnee Nation of Oklahoma. (His father and grandmother attended the Fort Sill Indian School near Lawton, Oklahoma.) "That was the narrative that [policymakers] told themselves to justify their actions—that we were not really human. But there were hundreds of very complex cultures, which had enormous achievements in architecture, mathematics, and science. And so much of that knowledge, of course, was intentionally destroyed or has since become lost."

When students returned home, they discovered that the indoctrination and abuse they'd experienced made them strangers. Reconnecting with family was hard: Often the children had lost fluency in their tribal tongue, while their parents did not speak English. Sometimes they were shunned by their communities for having forgotten their languages and ceremonies and for

SOREN WALLJASPER AND ROSEMARY WARDLEY, NGM STAFF; MIKE BORUTA. SOURCES: NATIONAL NATIVE AMERICAN BOARDING SCHOOL HEALING COALITION; TRUTH AND RECONCILIATION COMMISSION OF CANADA; BUREAU OF INDIAN AFFAIRS

DAWN NEPTUNE ADAMS, PENOBSCOT

Sent to foster care, Maine, 1978-1992

Adopted by a non-Native family, Adams was kicked out at 17 for registering to live in a dorm when she went to college—which meant her adoptive mother would no longer be paid for her care. "She sent my older adopted sister to my high school with an overnight bag," says Adams. "I was all of a sudden homeless with a month of high school to go."

wearing Western clothing—for becoming "white."

Nor were they adequately prepared for skilled jobs, having been mostly used as farmhands, laborers, or servants. When they escaped to the cities as adults, the former students were denied work, housing, and loans because of entrenched racism in a society that had falsely promised that education and assimilation were the ticket to success. Instead, many wound up homeless or in menial jobs, while many more went into the military as the only path to employment, fighting wars for a country that not only had failed in its trust and treaty obligations to tribes but also continued to engage in efforts to eradicate Native peoples, who were not granted American citizenship until 1924.

For decades, however, the survivors suffered in silence. Few talked about the trauma they experienced at boarding school. They held on to the horror and shame, struggling to survive and often falling into alcoholism, violence, and dysfunction in a generational cycle that continued with every new student.

THE BOARDING SCHOOL program ended in 1969 as part of the Johnson administration's push to begin addressing the poverty, destruction, and plight of Native American communities. But other federal policies that arose from the boarding school era perpetuated the cycle of pain for tribal communities, says Deborah Parker, the CEO of the National Native American Boarding School Healing Coalition.

"Boarding schools were the first 'Indian child welfare' policy established by the federal government, and after they closed, the U.S. sought other ways to pursue and monetize Native children in the adoption and foster care industries," says Parker, a member of the Tulalip Tribes of Washington State.

The American Indian Adoption Project, for example, was enacted in 1958 specifically to place







WILLIE STEVENS, SALISH

St. Ignatius Mission and School, Montana, 1964-1972

"I come from the generation … that lost our language, our culture," says Stevens. "My parents and grandparents didn't want to teach us the language, because they knew it would just hurt us." He remembers the nuns lining kids up with rulers. "If someone got in trouble, we all got to hit them," he says. "There are so many people now who aren't Catholic anymore." Now the school, a three-story brick building on the Flathead Reservation, is gone. "It would have been a really nice building that we could have used … but so many people were hurt by it that they wanted it torn down, so they tore it down."



CLARITA VARGAS, COLVILLE

St. Mary's Mission School, Washington, 1968-1974

Vargas had 12 siblings; six were sent to St. Mary's because of extreme poverty and her parents' instability. At the school, she was put to work. "We had to type these cards to request donations from people worldwide to support the missionary," she says. "I don't know how many we typed. It felt like hundreds, but when you put all the kids together, it was thousands. After we got them all typed, we had to go to the cafeteria and stuff the envelopes." She also peeled potatoes until her knuckles were raw. A teacher gave her a potato peeler for her birthday. "I just used it, and put it in the stack with all of the other 20 potato peelers."

PARENTS WHO RESISTED SURRENDERING THEIR CHILDREN WERE IMPRISONED AND DENIED FOOD RATIONS ON THE RESERVATIONS AS PUNISHMENT.

ESTHER NUQAQ'AQ GREEN, YUP'IK

Nunapitsinghak Moravian Children's Home, Alaska, circa 1948

"One day they came and took us... These people came and talked to my mother with an interpreter," says Green. "It was a bombshell to my being." She vowed to protect her brother, but she couldn't. "First, they separated us from our mom, and then they separated us from each other. There was nothing I could do. It was years and years until I saw [him] again."



Indigenous children with non-Native families, based on assumptions of white supremacy and middle-class values. Meanwhile, foster care systems began placing as many as 35 percent of all Indigenous children with almost entirely non-Natives. This practice became so widespread that Congress passed the Indian Child Welfare Act in 1978 to prevent the total destruction of Native communities by the states.

In 2019, Parker began working with then congresswoman Deb Haaland to draft legislation creating a federal commission similar to Canada's Truth and Reconciliation Commission. But the bill, and a parallel one in the U.S. Senate, has not yet been brought to a vote. Among the stumbling blocks is the issue of how to locate school and student records, many of which are scattered, incomplete, destroyed—or in the hands of religious institutions reluctant to acknowledge this painful past.

PATRICIA WHITEFOOT is now retired from a decades-long career in Native education. Her experience at the mission school inadvertently led her to a life in service of finding better, more culturally competent, and appropriate ways to respectfully and humanely meet the educational needs of Indigenous students.

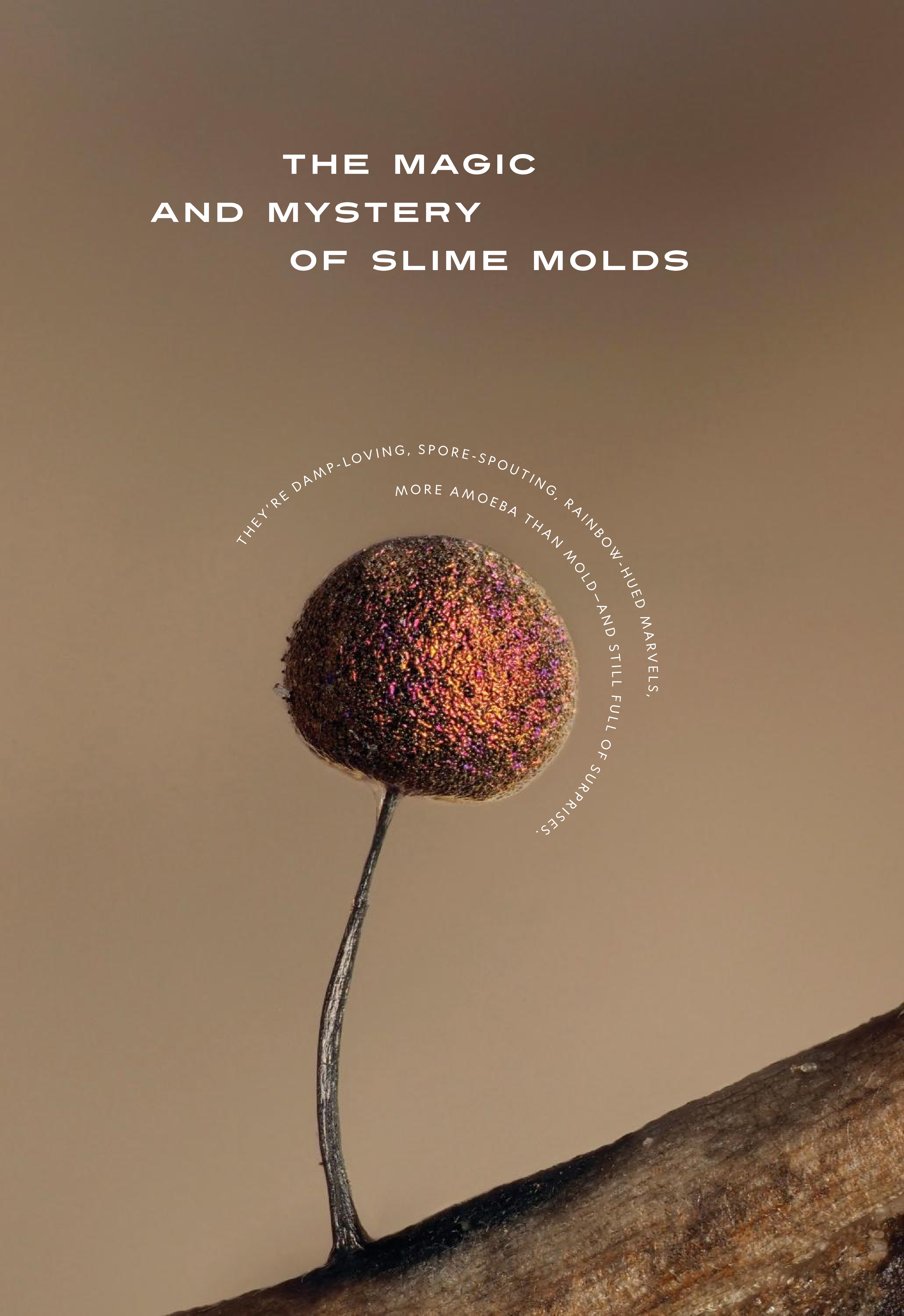
"I feel that we're at a point of reckoning with not only boarding schools but all of the intersections of our own humanity as Native people," says Whitefoot, who has three children, 10 grandchildren, and several great-grandchildren. "And this work has to be done in a very compassionate way that is holistic and collective, where we're all working toward the same goal of truth, justice, and healing of our people." ▫

A member of the Cherokee Nation, **Suzette Brewer** is a writer and producer who specializes in federal Indian law. Her grandfather attended the Chilocco Indian Agricultural School in Oklahoma.


Mark
John W. Mark
WILBU

THE MAGIC AND MYSTERY OF SLIME MOLDS

THEY'RE DAMP-LOVING, SPORE-SPOUTING, RAINBOW-HUED MARVELS, MORE AMOEBA THAN MOLD—AND STILL FULL OF SURPRISES.





PHOTOGRAPHS BY **ANDY SANDS**

Lamproderma scintillans
On a forest walk, look in damp areas for tiny, striking slime molds; these stalks topped with jewel-like spheres grow on the edge of a leaf. Andy Sands's images in this article capture slime molds in the reproductive stage, when they're easiest to spot.





Physarum leucophaeum
Slime molds propagate by packaging their spores in structures that range from puffy masses on a surface (aethalia) to colorful bulbs on stems (sporangia), such as these growing on moss.

THEY LOOK LIKE VISITORS FROM ANOTHER WORLD.

Some sprout short stalks capped with salmon-hued baubles; others collect in foamy-looking masses or sprawl in rippling yellow webs. Despite their otherworldly looks, these colorful globs are indeed Earthlings. They're slime molds, a hodgepodge of different species across multiple groups, some only distantly related. And despite their name, these blobby creatures are not related to mold but are among the large group of mostly single-celled organisms known as Amoebozoa.

Slime molds flourish in damp environments around the world, like the nooks of decomposing logs on forest floors. In your own backyard, they may emerge among the chips of mulch.

Mycologist Marie Trest of the University of Wisconsin-Madison fondly recalls a particularly wet summer when patches of slime mold speckled her yard. When she and her daughter sprayed the patches with a hose, spore-filled sacs burst, propagating the next generation. "We were just growing slime molds in the garden for the whole summer," Trest says.

The patches in Trest's yard were "dog vomit" slime mold, one of the plasmodial slime molds. They spend one phase of their lives as blobs searching for microorganisms to eat and another growing stationary spore structures in myriad hues and shapes. The group includes one of the stars of the slime mold world, the vivid yellow *Physarum polycephalum*. Creeping along on gooey tendrils, the species has intrigued scientists with its rudimentary "intelligence": Though it has no brain, it can identify the shortest path through a maze and remember food locations by imprinting them in the tubes that make up its body.

Despite scientists' research, many mysteries remain about slime molds. Why such brilliant colors? Why so many different shapes? How many species not yet discovered? "It's painful how much we don't know," says one of Trest's university colleagues, mycologist Anne Pringle.

"Much of Earth's biodiversity goes unnoticed, unrecorded, unstudied," she says. Slime molds are a magnificent reminder of those untold riches, waiting to be found. —MAYA WEI-HAAS



***Stemonitis* genus**
Spores for these slime molds grow inside clusters of finger-shaped sporangia.

For these images, photographer **Andy Sands** magnified the slime molds many times; most of them are only hundredths of an inch tall. Sands also used a process called focus stacking, in which multiple similar photos with different focal points are blended to achieve a more profound depth of field. Photographs via Nature Public Library.

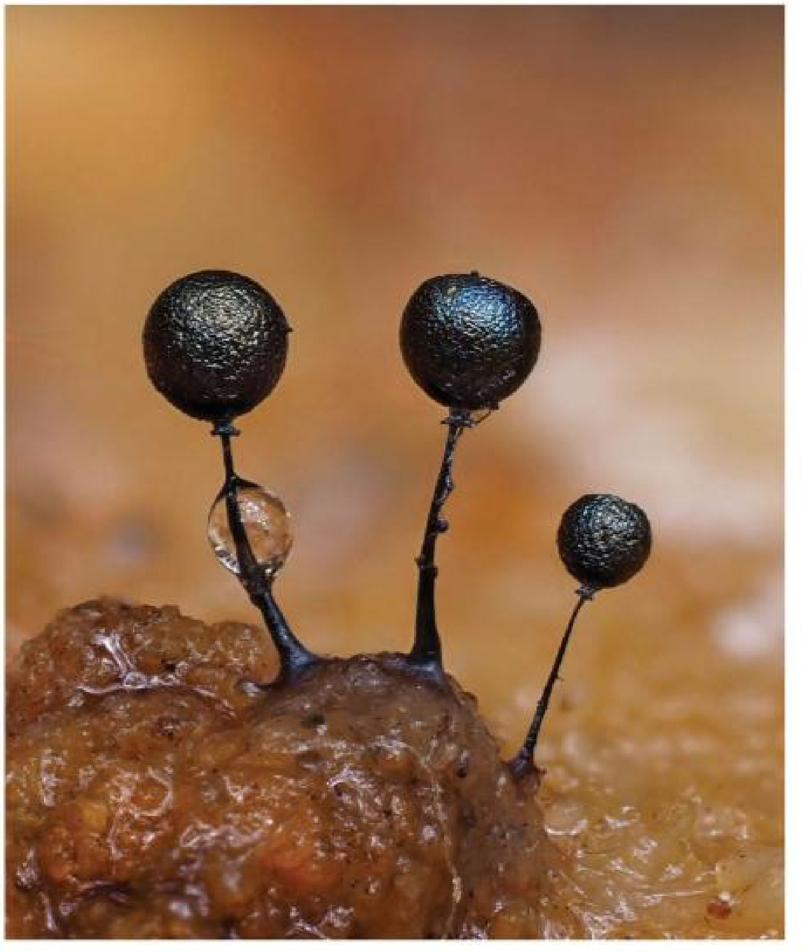






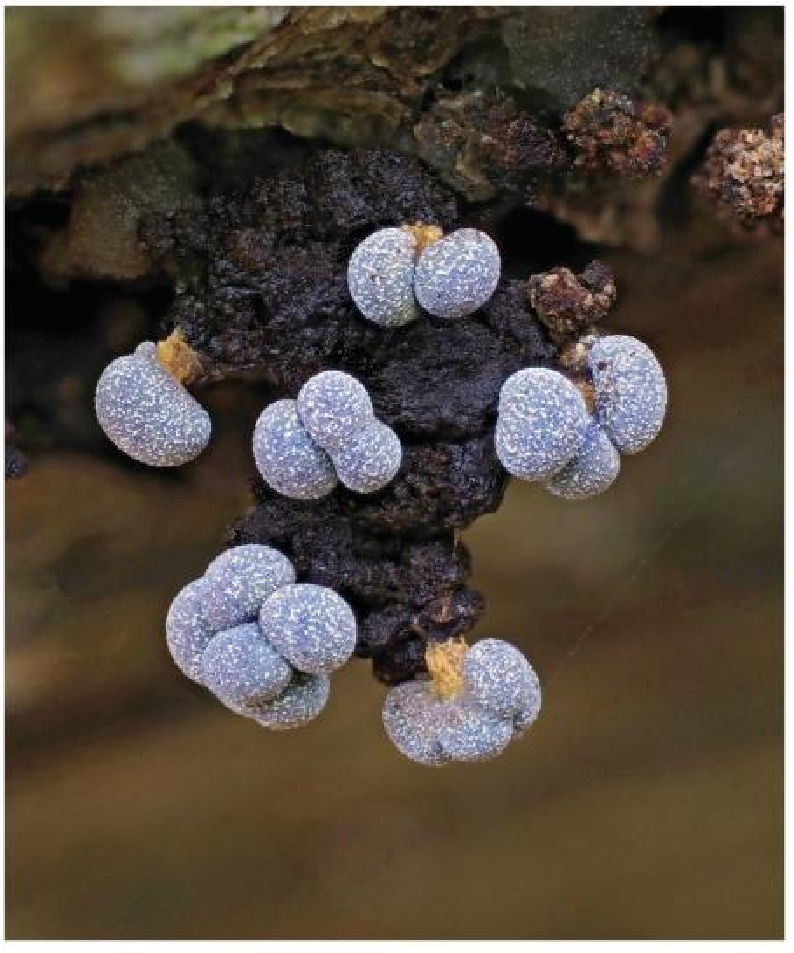
Cribraria argillacea
Though scientists don't know exactly what triggers slime molds to reproduce, they think the non-animal, nonplant, nonfungus creatures tend to enter their reproductive phase when conditions are unfavorable, such as their food or water supply running short.














All the slime mold species seen here are found in just two counties of southern England: Buckinghamshire and Hertfordshire. More have been identified in temperate zones compared to tropical, says ecologist Nikki Heherson Dagamac of the Philippines' University of Santo Tomas. The seeming lack of diversity in the tropics comes from the warm, wet conditions; slime molds thrive there so they're seldom in their showy reproductive phase, making new species tough to find: "There is a great chunk of hidden diversity in many of our ecosystems," Dagamac says.

TOP ROW, FROM LEFT: *ENERTHENEMA PAPILLATUM, COLLARIA ARCYRIONEMA, BADHAMIA SP., ARCYRIA POMIFORMIS*
BOTTOM ROW: *BADHAMIA UTRICULARIS, HEMITRICHIA CALYCULATA, TRICHIA BOTRYTIS, STEMONITOPSIS TYPHINA*





Metatrichia floriformis
When certain sporangia open, they unleash a jumble of colored filaments, called a capillitium, that may help launch spores into the environment. Visible as yellow specks, the newly released spores are the making of the slime mold's next generation.

THE LONG SHADOW OF WAR

BY ROBERT DRAPER

PHOTOGRAPHS BY JUSTYNA MIELNIKIEWICZ





To build a vital future, Kosovo seeks to be recognized as an independent country and to resolve its conflicts with Serbia.

PREVIEWS PHOTO

As the time for Friday prayer approaches, a crowd gathers outside the Bajram Pasha Mosque in the city of Mitrovicë. It was built on the site of a mosque damaged in the 1998-99 war with Serbia and is the largest in Kosovo. The country's ethnic Albanians are overwhelmingly Muslim.

RIGHT

Besarta Jashari's uncle, Adem Jashari, is honored as a martyred hero. He and his brother Hamëz, Besarta's father, fought with the Kosovo Liberation Army. In March 1998, Serbian police attacked the family compound in Donje Prekaze, killing 56. Besarta, then 10, was the only survivor.

IN KOSOVO, A VERY YOUNG COUNTRY of war-scarred survivors, everyone has a story that is almost too painful to recount—except here they are, alive to tell it, and insistent that the world listen. So it is that in the parliament building in the capital city of Pristina, I step into the office of the National Assembly's 36-year-old deputy speaker, Saranda Bogujevci, whose warm smile and firm handshake do not altogether succeed in deflecting attention from the deep, pale scars on her forearm above her disfigured left hand. Nor does Bogujevci shy from describing the origins of those wounds.

She was 13 on March 28, 1999, when a Serbian paramilitary unit descended on the town of Podujevë where Saranda and her family lived. The soldiers herded the 21 Bogujevcis into a garden, pushed them up against a wall, and opened fire. Then they departed, leaving a heap of lifeless bodies. Among them were a two-year-old boy, the family's matriarch, and Saranda's best friend and cousin, Nora. But five of the 21 were still breathing, including Saranda, who somehow survived 16 bullet wounds.

Bogujevci tells me she and Nora wore matching boots and she still has hers. "I learned with time that the memories are really important, and that I have to keep them, and I have to cherish them, and I have to save them," she says. Without these happier recollections, there is only damage to survey. "I did not ask for the past they gave me," she says of the Serbs. Casually glancing at her left arm and hand, she adds, "I have to live with it for the rest of my life. The past is not just the past."









Seeking revenge after the war, Kosovar Albanians destroyed Serbian Orthodox churches. The 14th-century Church of St. Nicholas, in Prizren, was unscathed but in 2004 was vandalized in an outbreak of anti-Serbian protests, the only widespread violence since the conflict ended.



Before she died, Nora had been joyful, imagining she would celebrate her upcoming 15th birthday in a liberated Kosovo. Four days earlier, NATO had launched its first air strikes, the culmination of a bloody conflict between Kosovar Albanians like the Bogujevcis, and Serbs, who had controlled the territory since the end of World War II. In 1989, the Serbian government began a "soft" ethnic cleansing, before long dismissing ethnic Albanian state workers like Bogujevci's father, an electrical engineer, and forbidding ethnic Albanian children like Saranda from attending public schools. Kosovar Albanians resisted, peacefully at first but eventually waging an insurgency to seek independence. In the summer of 1998, Serbian authorities forced the evacuation of hundreds of thousands of ethnic Albanians. After NATO's intervention, they unleashed a campaign of ethnic cleansing, killing thousands of civilians and burying many in hidden mass graves.

Bogujevci tells me about a group of women she met while visiting her family's grave site in Podujevë. The women, some quite young, told Bogujevci that their families had been apprehended by Serbian authorities and never seen since. The women had gathered there, they said, because they had no memorial of their own. Families like theirs hold out hope the graves of



In a reflection of the ethnic enmity that still plagues the Balkans, the Ibar River slices Mitrovicë into a Serb section and an Albanian one. The New Bridge is guarded by Italian peacekeeping troops and open only to pedestrians. In 2004, Serbs and Kosovar Albanians traded gunfire here, leaving eight dead and triggering deadly unrest across Kosovo.

more than 1,600 victims still missing will someday be found.

Today the deputy speaker of Kosovo's parliament helps oversee a Balkan country that, a decade and a half after it declared its independence from Serbia in 2008, remains beset by economic, cultural, and geopolitical challenges. Such hurdles are imposing but also surmountable. What has proved more vexing is Kosovo's yearning to be Kosovo.

What Kosovo wants are things other nations have wanted and received in the past. It wants resolution of the myriad war crimes committed by Serbian forces. It wants to be acknowledged as an independent nation by the entire world. Of the 193 United Nations member states, over a hundred have at one time or another recognized Kosovo as a country. Among those that do not, for geopolitical reasons of their own, are Serbia, Russia, Spain, Greece, Mexico, Argentina, South Africa, and China. Kosovo also wants to control the entirety of its territory. Serbian-majority regions in the north remain effectively governed by its neighbor. And yes, it wants a self-sufficient economy, a better educational system, and greater job opportunities for its youth and its women.

But Albanian Kosovars insist that they cannot fully face these challenges while demons of the past loom over the country unexorcised. As Vjosa Osmani, the president of Kosovo, told me when we met in her office: "For these past 20 years, the international community has asked Kosovo to just swallow the pain, not talk about the past, not talk about the crimes that were committed against us. They promised us a much better and brighter future if we only look forward and don't ever seek justice for what was done against our people. But when you don't tell the truth about your own country's history, then someone else will twist the truth. They will revise that history for their own purposes."

KOSOVO'S CHALLENGES would be formidable enough without its regional difficulties. A small country about the size of Lebanon, it is a landlocked, diamond-shaped territory bordered by larger countries (Serbia, North Macedonia, Albania, and Montenegro). Though Kosovo's status as having the youngest population in Europe augurs a promising future, at present its unemployment rate is the highest on the continent and its economy has a negative balance of trade.

To be sure, the infant country has made progress. When NATO troops landed in Kosovo in June 1999, one of the eyewitnesses to the country's liberation from Serbian control was an 18-year-old war refugee named Vlora Çitaku, who served as an interpreter for the international media. Nine years later, after serving in parliament, as Çitaku tells it, "I was literally handed a piece of paper and told, 'You're deputy foreign minister.' I literally had nothing: no computer, no staff, no office. There was no foreign ministry! We had to build everything from scratch."

KOSOVO IN LIMBO

The tiny Balkan country's 1998-99 war to break free from Serbia—after centuries as part of the Ottoman Empire and then Yugoslavia—ended in an uneasy and unresolved stalemate. Now, 15 years after the former province of Serbia declared independence, the country of nearly 1.8 million people—overwhelmingly ethnic Albanian and Muslim—is still striving for global recognition.



Breakup of Yugoslavia
The country dissolved after communism collapsed in Europe. The first republics left the federation in 1991. Since then, wars and violence have claimed 140,000 lives.

Toward a place in the European Union
Kosovo and Serbia both seek to join the partnership but must first normalize their relations. They remain in conflict, as Serbia still claims Kosovo as its territory.

ROSEMARY WARDLEY, NGM STAFF; BRANDON SHYPKOWSKI. SOURCES: FLORIAN BIEBER, UNIVERSITY OF GRAZ, AUSTRIA; TODD M. JOHNSON AND BRIAN J. GRIM, EDS., WORLD RELIGION DATABASE; KOSOVO AGENCY OF STATISTICS; STATISTICAL OFFICE OF THE REPUBLIC OF SERBIA; STATISTICAL OFFICE OF MONTENEGRO; AGENCY FOR STATISTICS OF BOSNIA AND HERZEGOVINA; CROATIAN BUREAU OF STATISTICS; REPUBLIC OF SLOVENIA STATISTICAL OFFICE

In 2015, Çitaku became Kosovo's ambassador to the United States, a witty, stylish, and driven diplomat who spent her five years in Washington seeking to impress upon the Obama and Trump administrations that Kosovo should be regarded by the allies who midwifed it into being as "unfinished business," a country not yet fully capable of charting its own destiny.

At the time that Kosovo formally declared its independence, its government's operating budget was just $933 million. Today that figure has quintupled. Still, the government's grip on its sovereignty remains precarious. Among Kosovo's 38 municipalities, 10 are under some form of Serbian control, with mayors who are widely seen as proxies for the neighboring government.

The capital city of Pristina is urbane and European, its cafés teeming at all hours. But a little more than six miles away lies Gračanica, seemingly in another country altogether, where the common currency is not the euro but the Serbian dinar. The town's centerpiece is a magnificent 700-year-old Serbian Orthodox church a short walk from a statue commemorating a 14th-century Serbian hero, a knight named Miloš Obilić. Serbian flags predominate, as well, along the road to the border town of Zubin Potok—a thoroughfare that is sometimes barricaded by Serbian forces several miles inside Kosovo.

To be a citizen of a country like Kosovo that is not universally recognized means an inability to travel freely, even to other European countries, without a special visa. But Kosovo's fraught relations with Serbia hamper its progress in more insidious ways. As Berat Rukiqi, the president of Kosovo's chamber of commerce, explained to me, "The key for investors is predictability, which is related to political risk. Here, we fail. Because for them, Kosovo is an unfinished story. The story is, 'Kosovo belongs to Serbia.' "

As Çitaku puts it: "Why would someone serious come and invest in a no-man's-land? Kosovo, for me, it is a state. But if you google it, it's a contested territory. And each time we try to privatize a company and each time a bidder would come in, two days later they would receive a note from Serbia saying, 'We will sue you if you buy that property, because it's ours.'

"It complicates the business climate," the former ambassador sighed. "It complicates the political climate. It complicates everything."

TO LEARN MORE about the region's tumultuous history, I went to Gazimestan, a memorial near Pristina commemorating the Battle of Kosovo in 1389. A security guard and his two dogs greeted us. No one else was there to view the structure. Built in 1953 to look like a medieval tower, it rises above an otherwise vacant field. When I commented jokingly to the guard that he was lucky to have the dogs to keep him company, he assured me that it was crowded on holidays, when busloads of tourists drove in from Serbia

KOSOVO IN CONTEXT

Through centuries of shifting rule, the region's people have sought to assert their own identity.

1389: THE BATTLE OF KOSOVO

The Ottoman Empire defeats Christian soldiers from Balkan states, ushering in more than five centuries of Ottoman rule.

1913: ABSORBED INTO KINGDOM OF SERBIA

After Serbia, Bulgaria, Greece, and Montenegro defeat the Ottoman Empire in a war, Serbia gains control of Kosovo.

1918: FORMATION OF YUGOSLAVIA

Kosovo becomes part of the Kingdom of Serbs, Croats, and Slovenes, which in 1929 is renamed Yugoslavia.

1945: SOCIALIST FEDERATION

After World War II, Kosovo officially becomes an autonomous province of Serbia in communist-ruled Yugoslavia.

1974: AUTONOMOUS STATUS GRANTED

Kosovo is given greater autonomy under the Yugoslav Constitution, with rights that are similar to those of a republic.

1989: AUTONOMOUS STATUS ABOLISHED

Serbia ends Kosovo's autonomy and marginalizes its ethnic Albanian majority. Soon after, Yugoslavia collapses as its republics begin declaring independence.

1998-99: KOSOVO WAR

Serbian forces clash with the Kosovo Liberation Army, triggering NATO intervention. The hostilities and ethnic cleansing displace almost 90 percent of the population.

2008: INDEPENDENCE

Kosovo declares independence. The United States and much of Europe recognize it, but many other countries do not.

2011: NORMALIZING RELATIONS

Kosovo and Serbia begin talks led by the European Union, reaching some agreements, but Serbia still does not accept Kosovo's independence.



Kosovar Albanians massed on the border with Albania in March 1999, wearing as much as they could to protect against the cold and avoid carrying extra baggage. After NATO intervened in the war, Serbian forces waged a brutal campaign of ethnic cleansing, driving most of Kosovo's ethnic Albanians from their homes.
FRANCESCO ZIZOLA/VII/REDUX



THEY HAVE NOT SUCCUMBED TO THEIR WOUNDS.

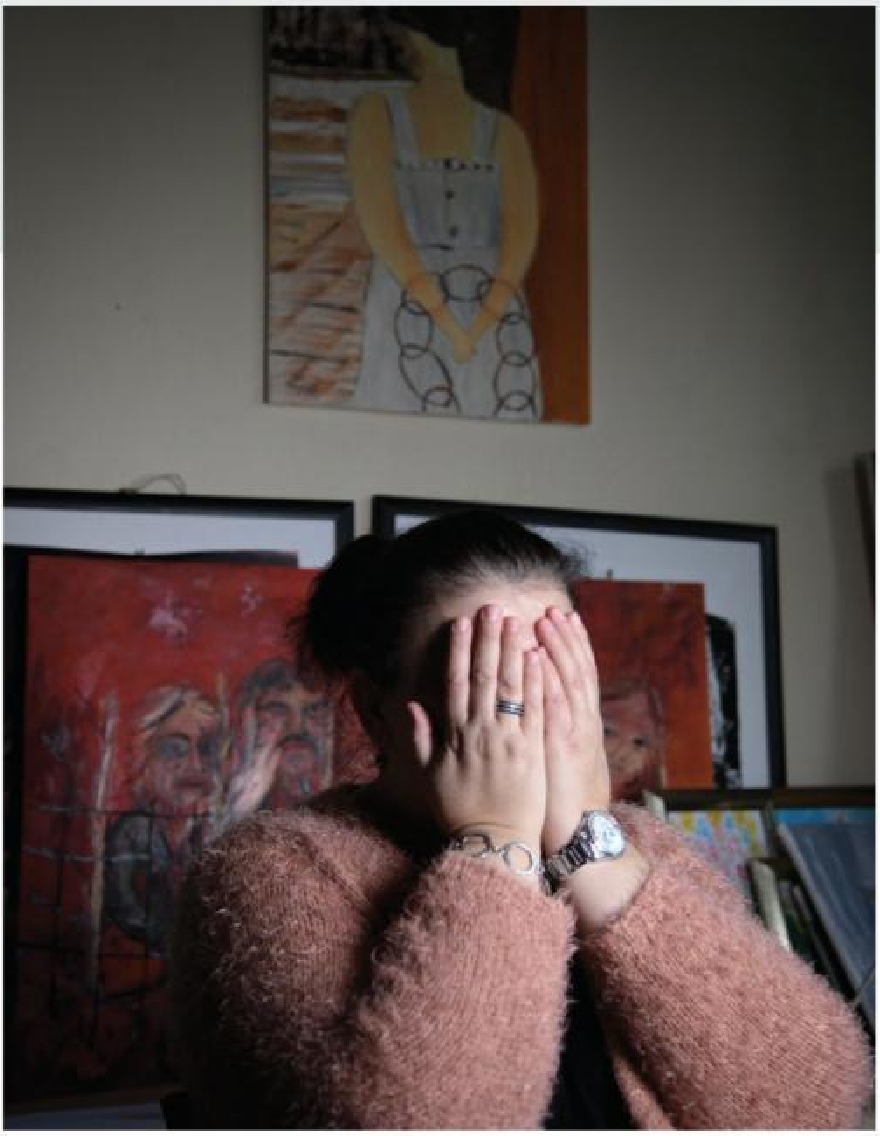
TOP LEFT
This Bosnian woman, who asked not to be identified, was raped twice in the wars that followed Yugoslavia's disintegration, first in Bosnia, then in Kosovo. She posed in the art therapy room of a nonprofit in Gjakovë that offers counseling to sexual assault victims.

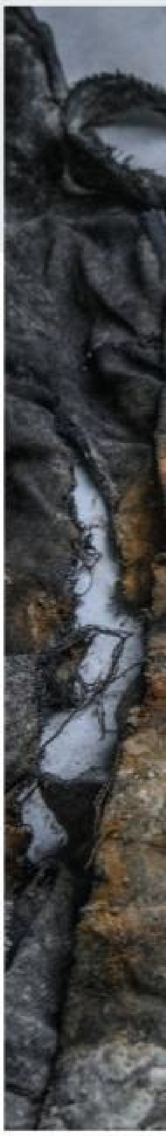
TOP RIGHT
Saranda Bogujevci, who was elected to parliament in 2021, survived when most of her family was rounded up and executed by Serbian forces. As teenagers, Bogujevci and three cousins were the first ethnic Albanian victims to testify before a Serbian court about the atrocities.

MIDDLE PHOTOS
This vest and shoe were unearthed from mass graves of Kosovar Albanians killed by Serb forces. Items not linked to a victim, like these, are stored at the Institute for Forensic Medicine in Pristina.

BOTTOM LEFT
Jasmina Jovanović holds the only photo she has of her father, Paun Živković, a Serb who was the head of a technical school in Ferizaj. After the war he returned to retrieve files but disappeared. Jovanović leads a group trying to learn what happened to missing Serbs.

BOTTOM RIGHT
Vasfije Krasniqi-Goodman, with her niece Anda at her brother's home in Fushë Kosovë, became the first ethnic Albanian woman to talk openly, in 2018, about being raped, raising awareness of the suffering of women who were sexually assaulted during the conflict.



















to pay homage. The monument, designed by a Serbian architect, is dedicated to the enduring significance of Serbian martyrdom.

Serbia's identity of valor and sacrifice is as bound up with the Battle of Kosovo as is that of Texas with the Battle of the Alamo. The oddity of the bloody one-day battle is that the losing effort against Ottoman Empire troops was waged not just by Serbs but also by a coalition that included Bulgarians, Albanians, and several other Christian nationalities. Furthermore, the singular significance of the Battle of Kosovo to the Serbian population did not take on such intense geopolitical overtones until June 28, 1989, when Serbia's president, Slobodan Milošević, stood before the Gazimestan monument and declared: "The Kosovo heroism has been inspiring our creativity for six centuries and has been feeding our pride and does not allow us to forget that at one time we were an army great, brave, and proud, one of the few that remained undefeated when losing." Kosovo's centrality to the Serbian collective consciousness has remained fixed ever since. Indeed, on the way from Belgrade's airport to my hotel in the regal capital city, among my first sights was graffiti on an overpass that read: KOSOVO IS SERBIA.

The complication with this Serbian narrative,



Fahrije Hoti (in red pantsuit) appears at the Pristina premiere of *Hive,* a movie based on her life. In the war, Serbian police seized her husband and most other men in Krushë e Madhe. Many have never been found. To survive after the war, Hoti organized the village's women into a collective, which initially raised bees to make honey.

then and now, is that Kosovo was and is populated overwhelmingly by ethnic Albanians. Their distinct language, culture, and Islamic faith made them an awkward fit in the otherwise Slavic and largely Christian composition of Yugoslavia during its communist years. "In the beginning of that era, it wasn't so important whether you were Serb or Albanian," says Bojan Popović, a director of the National Museum in Belgrade. "And by the end, it was the only thing that mattered."

Milošević's speech at Gazimestan inaugurated a decade-long effort to impose a Serbian identity on the Kosovo population by force. Albanian-language newspapers were shut down, municipal governments dissolved, and ethnic Albanians banished from civic life.

"I grew up with Serbian employees coming to our house, destroying everything," Vasfije Krasniqi-Goodman, a 39-year-old woman with elegantly angular Balkan features, told me one evening while wearily smoking a cigarette in a Pristina restaurant. The authorities, she recalled, were looking for her father, whom they suspected of having an unlicensed gun, and for her brother, who had gone AWOL from the army. In April 1999, when she was 16, the Serbs came for her. Two men, one a police officer, raped her—first in the back of a car, then in an empty house.

She and her family fled to the mountains. But even after NATO liberated Kosovo, the girl felt marked by what had happened to her. She married a UN peacekeeper and returned with him to Arkansas. She had two children, divorced, moved to Dallas, and while waiting tables, met a shy engineer named Shawn Goodman who had no idea where Kosovo was, much less what a young woman like her would have experienced there. They married. Still, the past remained with her. She decided to embrace that reality.

In 2018 she returned to Pristina and appeared before a nationally televised audience. Though it was well known that some 20,000 ethnic Albanians—most but not all of them women—had been sexually assaulted during the war, no survivors had openly told their story in a public forum, until then. Vasfije Krasniqi-Goodman became widely recognized in Kosovo. Two years later she ran for parliament. At home in Texas, she learned she'd won.

A medical condition that made international travel unbearable would force Krasniqi to vacate her seat 19 months later. But as a lawmaker, she had assigned herself an unusual though fitting portfolio. "I meet with survivors," she told me while she was still in parliament. "It's one of the most important things I do." Since the Kosovo government did not have the resources to provide her with an office, she would meet with them in coffee shops and listen to their stories. Their refrain was hauntingly familiar.

"All of them," she said, then amended herself: *"We.* We want justice." The odds of that are bleak, as Krasniqi-Goodman well knows. Many Serbians suspected of war crimes, including some prominent officials, have never been prosecuted. Milošević was tried by a UN tribunal for war crimes, but in 2006 he died of a heart attack in a

AN ETHOS OF SELF-DETERMINED RESILIENCE PERVADES THE 15-YEAR-OLD COUNTRY.



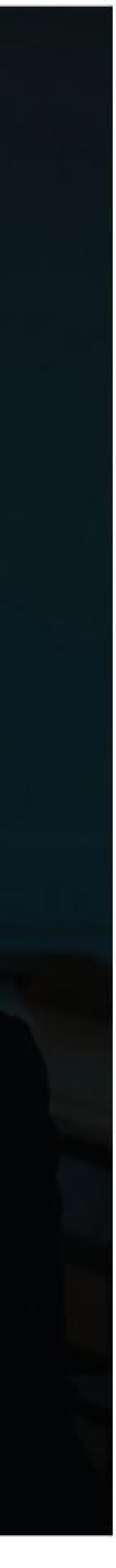
RIGHT
Lindita Sejdiu-Rugova is dean of the Faculty of Philology at the University of Pristina. She led efforts to restart a program on Balkan languages in which Serbian will again be taught. Among the goals: to improve translations and to foster communication between Kosovo's Albanians and Serbs. Both Albanian and Serbian are official languages.

OPPOSITE TOP
The collective that Hoti founded began with an apiary but turned to processing red bell peppers, which grow in the region. The factory produces ajvar, a traditional sauce made with roasted peppers. To succeed, Hoti and the women had to fight the region's patriarchal attitudes.

OPPOSITE BOTTOM
Members of Ashikët (Lovers), a band from Gjakovë, gather for a CD photo shoot. They have played together for decades. In 1999, the band's leader appeared with a men's choir to sing the Albanian national anthem at the funeral in Reçak for 45 unarmed Albanian Kosovars killed by Serbian security forces.









Serbian tourists from Belgrade, Serbia's capital, visit Prizren's Church of the Holy Savior, which was built around 1330. At that time the city was the capital of the Serbian Empire, but today few Serbs live there. The Sinan Pasha Mosque (at right) was built in 1615, when the Ottoman Empire ruled Kosovo.



> ‘WHEN YOU DON’T TELL THE TRUTH ABOUT YOUR OWN COUNTRY’S HISTORY, THEN SOMEONE ELSE WILL TWIST THE TRUTH.’
>
> VJOSA OSMANI, PRESIDENT OF KOSOVO

prison cell before the trial’s conclusion. One of the killers of Bogujevci’s family was sentenced to 20 years but was let out several years early for “good behavior,” only to be arrested later for running a drug cartel. Krasniqi-Goodman’s attackers were convicted, but the verdicts were later overturned.

IN JUNE 2021, Nenad Čanak, a former member of Serbia’s National Assembly and now an opposition party leader, crossed the border to meet with Kosovo’s prime minister, Albin Kurti. What Čanak also did across the border would arouse more controversy back home than his dialogue with the hated Kurti: He visited the village of Mejë and laid flowers on the site where in 1999 Serbian soldiers and police massacred more than 370 Kosovar Albanians, transported their bodies to the Belgrade suburb of Batajnica, and buried them en masse.

“I saw these things with my own eyes,” Čanak said when we met in his office in Novi Sad, Serbia’s second largest city. He added dryly, “Now we have this peculiar situation: If you don’t believe the Serbian government, but instead believe your own eyes, you’re a national traitor.”

I tried unsuccessfully to secure permission to visit the Batajnica site, which was discovered in 2001 on the grounds of a Serbian police compound. The fact that the Serbian government refuses to allow unfettered access or publicly mark the mass graves tends to complicate the country’s assertion that it has turned the page from the belligerence of the Milošević era.

Its president, Aleksandar Vučić, was Milošević’s propaganda minister and in 2018 hailed the former president as “a great Serbian leader.” Its first deputy prime minister, Ivica Dačić, was Milošević’s spokesman. More insidiously, the current unofficial Serbian policy known as passivation of residential addresses—in which authorities have reportedly forced thousands of Albanian residents to leave Serbia after being unable to show their registration records on demand—would seem to resemble, as the Helsinki Committee for Human Rights in Serbia put it in a scathing report, “a form of ethnic cleansing through administrative means.”

It happens that both Serbia and Kosovo wish to enter the European Union, but neither can do so without a “normalization” accord. Despite years of talks, such an eventuality seems light-years away. While in Belgrade, I met with Dušan Milenković, a political consultant. He told me, “The NATO bombing remains the most important event for the Serbian people.” The damage done by the shelling was above all psychological, he explained, because the Serbs were proud people who had fought on the right side during the two World Wars, a legacy now buried under a global narrative that casts Serbs as villains. “This creates a kind of defensive position that can distort the rational mind,” Milenković said, adding that most Serbs were eager to normalize relations—but not if it required further wallowing in the past. “The Kosovo government is pushing the narrative of accountability,” he said. “If there’s ever an agreement, that’ll first have to fall off the table.”

The stalemate between the countries sparks flare-ups with alarming regularity. During my three weeks in the region in late 2021, the Kosovo government retaliated against the long-standing Serbian policy of not permitting cars bearing Kosovo license plates to come into the country since this would amount to de facto recognition of the latter’s sovereignty. Suddenly, it was decreed, Serbian-plated cars could not enter Kosovo either. The license-plate imbroglio meant that my Serbian driver had to let me out a hundred yards from the border checkpoint, which I had to walk through to meet a Kosovar driver waiting to ferry me to Pristina.

Nearly a year later, in September 2022, Kosovo’s

government added a new wrinkle: Its resident Serbs, less than 5 percent of the population, would have to forsake their Serbian license plates to keep driving in Kosovo. The edict was met with vehement resistance, including barricaded streets, before international pressure compelled Kosovo officials two months later to turn down the temperature by simply issuing warnings to drivers. Even so, Vučić ordered Serbian troops to the border. In December the Serbian leader, responding to pressure from the West, persuaded protesters to remove the barricades.

THE MANY KOSOVARS with whom I spoke seemed well aware that the outside world views the ongoing Kosovo-Serbia impasse warily. That apprehensiveness certainly extends to America, which was instrumental in Kosovo's liberation. The latter country's appreciation for the former is obvious to anyone who strolls through Pristina and sees the statues of Bill Clinton, Madeleine Albright, and Bob Dole. Still, that Kosovo is in every meaningful way dependent on the U.S. government—which in March 2022 announced it would commit an additional $31.9 million in assistance to the billion dollars spent in Kosovo since 1999—is a double-edged sword. Preoccupied with the war in Ukraine, U.S. policymakers do not wish to be drawn into a proxy war in the Balkans, where Serbia maintains a strong alliance with Russia. The desire not to inflame tensions has meant, for example, that Kosovo acquiesced to the Serbian government's demand that its war-era paramilitary group, the Kosovo Liberation Army, or KLA, be investigated for war crimes. The country's former president, who was a KLA official, faces trial in a special court in The Hague. Last year the court convicted a former KLA commander.

Still, an ethos of self-determined resilience pervades the 15-year-old country. Its parliament, after all, includes Saranda Bogujevci, a survivor of unfathomable violence. Its president, Vjosa Osmani, was marched at gunpoint across the border to Albania as a teenage girl. A former president, Atifete Jahjaga, now head of a pro-democracy NGO, spent five months hiding in a darkened Pristina apartment before NATO troops freed her and her family. Its prime minister, Albin Kurti, was confined with 30 other men in a tiny cell before being dragged out and used as a human shield during the NATO bombardment. In Kosovo the survivors are now the leaders. They have not succumbed to their wounds.

Of all the inspiring figures I met in Kosovo, the most unassuming was Fahrije Hoti, a 52-year-old businesswoman with keen eyes and a preoccupied air. She lives in the agricultural village of Krushë e Madhe, a peaceful place until the Milošević era, when, as she told me, "Every morning we would wake up and say, 'Whose turn is it to get arrested or killed today?' "

Before dawn on March 25, 1999, Serbian tanks advanced on the village. Hoti urged her husband to run, and she fled with their two children to the forest. They returned the next day to find that Serbian police had taken over. The women, children, and elderly men were marched 13 miles to the city of Gjakovë where, they were told, mass graves awaited them. Hoti slipped away from the throng while carrying her all-but-lifeless infant son. She found her daughter, whose feet were caked with blood from marching on broken glass, as well as her father-in-law. They escaped to Albania, where they lived in tents with thousands of other refugees. On June 22, 1999, Hoti, her children, and her father-in-law returned to find Krushë e Madhe had been reduced to ashes. All its young men had disappeared. Her husband's body has never been found.

But that is only where her story begins. For in this ghost village, Hoti said, "I had to play the role of a man." More precisely, she rallied the other women to form a cooperative. First they had an apiary. In 2005 a better idea emerged: They would buy the ubiquitous red bell peppers from farmers and make ajvar, a traditional sauce.

Some men ridiculed her for not finding a more feminine occupation. "It just made me more determined not to stop," she recalled.

Today Hoti's company processes more than 1,300 tons of red peppers a year. She employs more than 70 women and young men. She is still looking for her husband. She is still waiting for an apology.

When I asked whether she could imagine that Serbia would ever recognize Kosovo, the pepper entrepreneur of Krushë e Madhe replied in a flat, even voice: "They have no choice. We are still here." ☐

Robert Draper, a reporter for the *New York Times,* is a longtime *National Geographic* contributor. **Justyna Mielnikiewicz** is a freelance photographer from Poland who's based in Tbilisi, Georgia.



A YEAR OF

The Arctic archipelago of Svalbard is the fastest-warming place on Earth. To document how climate change is affecting the land, water, and wildlife, a photographer lived there through four seasons.



Svalbard's bay of Sassenfjorden—here, in early March—spreads out beyond peaks favored by hikers. The Norwegian archipelago's smaller fjords once froze over in winter, but warmer temperatures now keep the water flowing in some year-round.

EXTREMES

PHOTOGRAPHS BY STEFANO UNTERTHINER

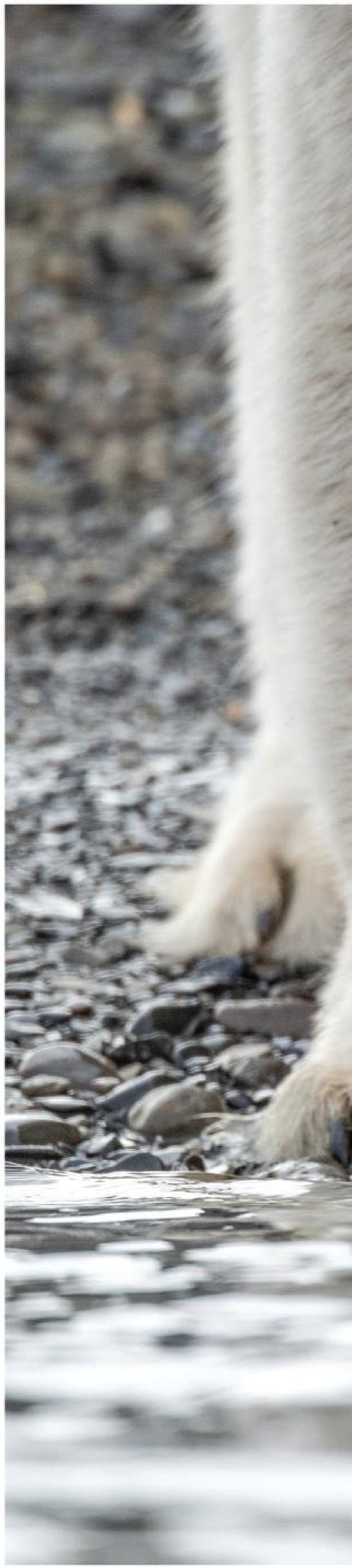


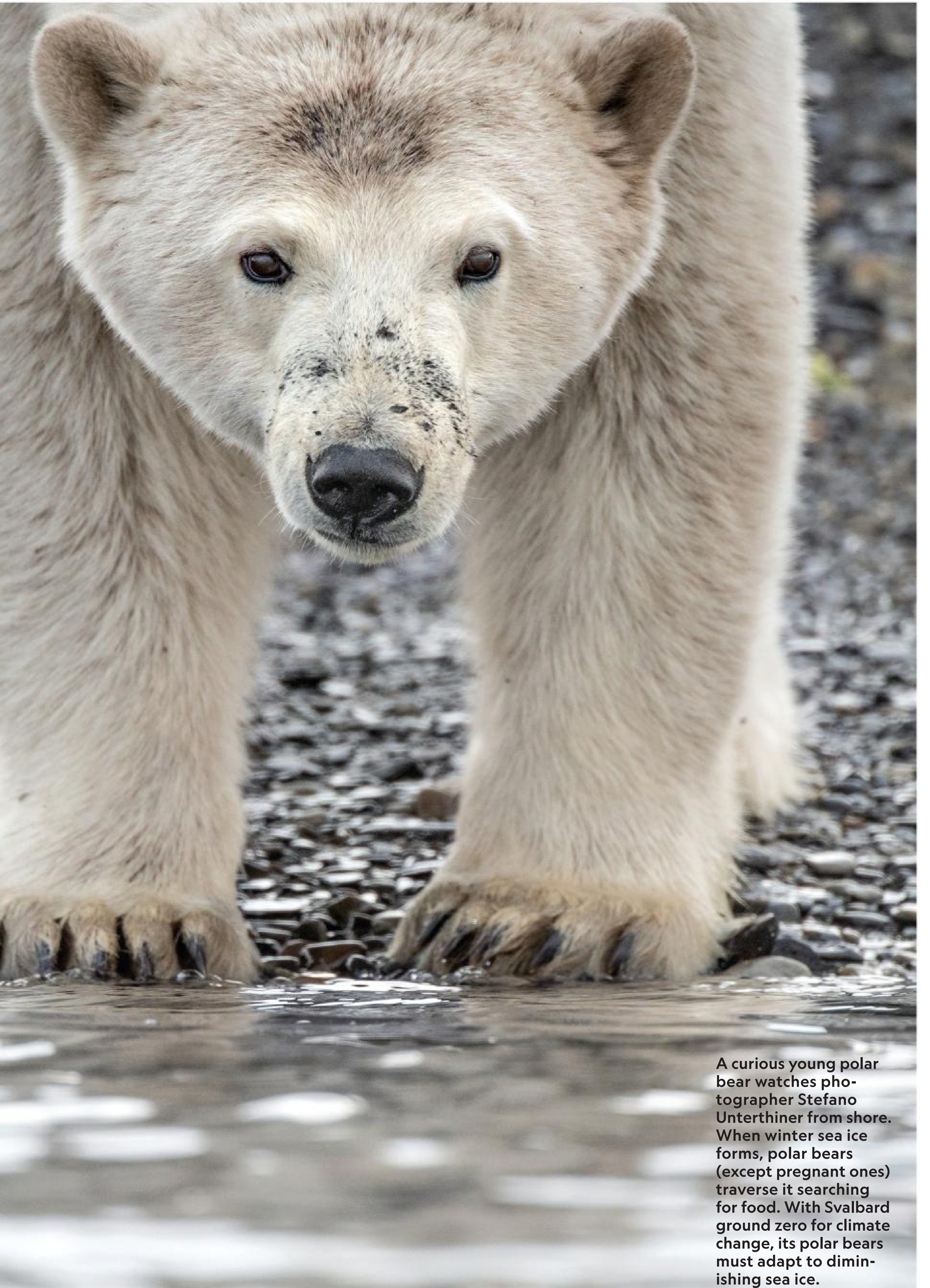
MATTHEW W. CHWASTYK, NGM STAFF
SOURCES: NASA; GEOLOGICAL SURVEY OF NORWAY

"IT MAKES YOU SMALL," Stefano Unterthiner says of Svalbard, the Norwegian archipelago perched in the high Arctic, where he and his family spent a year. In 2019 the Italian photographer moved with his wife, Stéphanie, and their young son and daughter to Longyearbyen, Svalbard's largest settlement. They felt at ease right away: Though the town is home to only about 2,100 people—scientists, tour operators, students—they come from around the globe and represent some 50 nationalities.

To learn how a vulnerable ecosystem changes in this fastest-warming place on Earth, Unterthiner went in search of Arctic wildlife. He traveled by snowmobile and on foot, equipped with binoculars and a mandatory rifle, as well as camera gear. He found fjords melting, avalanches increasing, and rain-drenched permafrost icing over the vegetation the wildlife must eat to survive.

Unterthiner fears the area is "changing so quickly that most of the species—because they are so adapted to this environment—eventually won't be able to evolve in such a rapid way." —NINA STROCHLIC





A curious young polar bear watches photographer Stefano Unterthiner from shore. When winter sea ice forms, polar bears (except pregnant ones) traverse it searching for food. With Svalbard ground zero for climate change, its polar bears must adapt to diminishing sea ice.





Male Svalbard reindeer fight over a harem of females that one had gathered during mating season. The winner chased the loser away. Rainfall instead of snow imperiled reindeer, encrusting the plants they survive on in ice.



At the end of May, barnacle geese reach their breeding areas on high cliffs in some parts of Spitsbergen, Svalbard's largest island. Right before females lay their eggs, the mated males and females remain together to defend their nesting sites from other pairs.









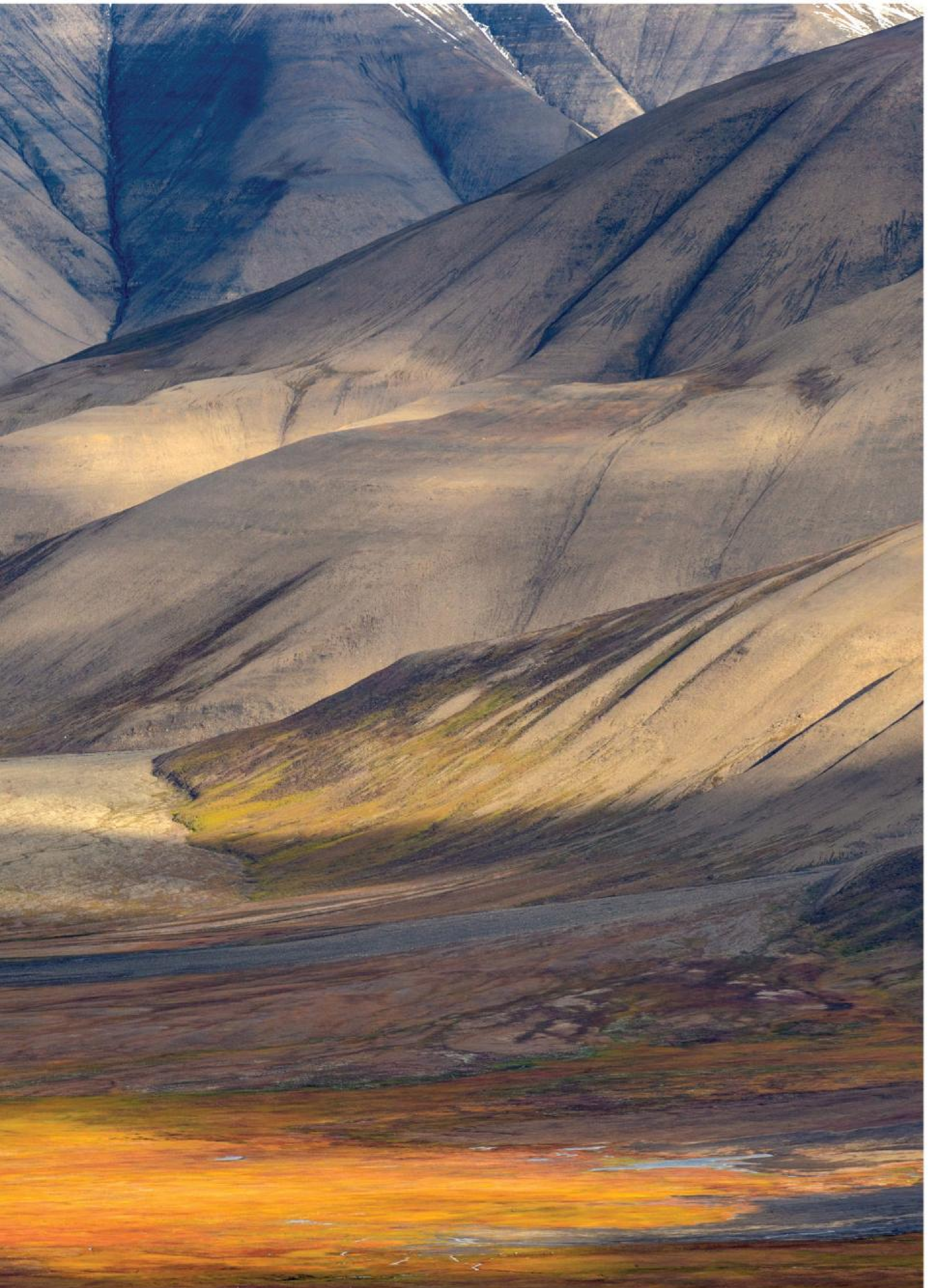


Arctic foxes grow thick, protective coats in winter. Left: A fox looks for scraps on the picked-clean carcass of a reindeer, a sought-after winter food source. Once summer arrives, foxes feed primarily on eggs and chicks from nests and occasionally on seal pups.

Above, top: To try to repel a hunting fox, an arctic tern will dive and peck—so effectively that other species nest near it to benefit from its protection. Bottom: A fox steals an eider duck egg. To aid their winter survival, foxes raid bird colonies and cache food in summer.



What really surprised Unterthiner during his year in Svalbard? “The transformation of this environment is so quick,” he says. In August in Adventdalen, a valley on Spitsbergen, he marveled at this view: the tundra colors changing as the short Arctic summer ended.











In Adventdalen, a Svalbard reindeer patrols the group of females he's gathered for mating (left). A female reindeer's seven-month pregnancy typically ends in June with the birth of a single calf (top). Once hunted nearly to extinction, this subspecies—which is endemic to Svalbard—has rebounded substantially. But survival is hardly guaranteed, especially for the young, such as the calf or the two immature males sniffing each other after play-fighting during rutting season (bottom).





From a cliff above the Bjørndalen valley, Unterthiner spotted movement on the drift ice below. “It’s a dream to find a bear,” he says, but “kind of a night-mare at the same time.” Svalbard’s polar bears and humans have a tenuous relationship; each species has killed the other, albeit rarely.



PICTURES OF THE YEAR PHOTO CONTEST

KARTHIK SUBRAMANIAM

GRAND PRIZE WINNER

WHO

A software engineer and hobbyist photographer, based in San Francisco

WHERE

Alaska Chilkat Bald Eagle Preserve

WHAT

Sony Alpha 1 camera with a 600mm lens

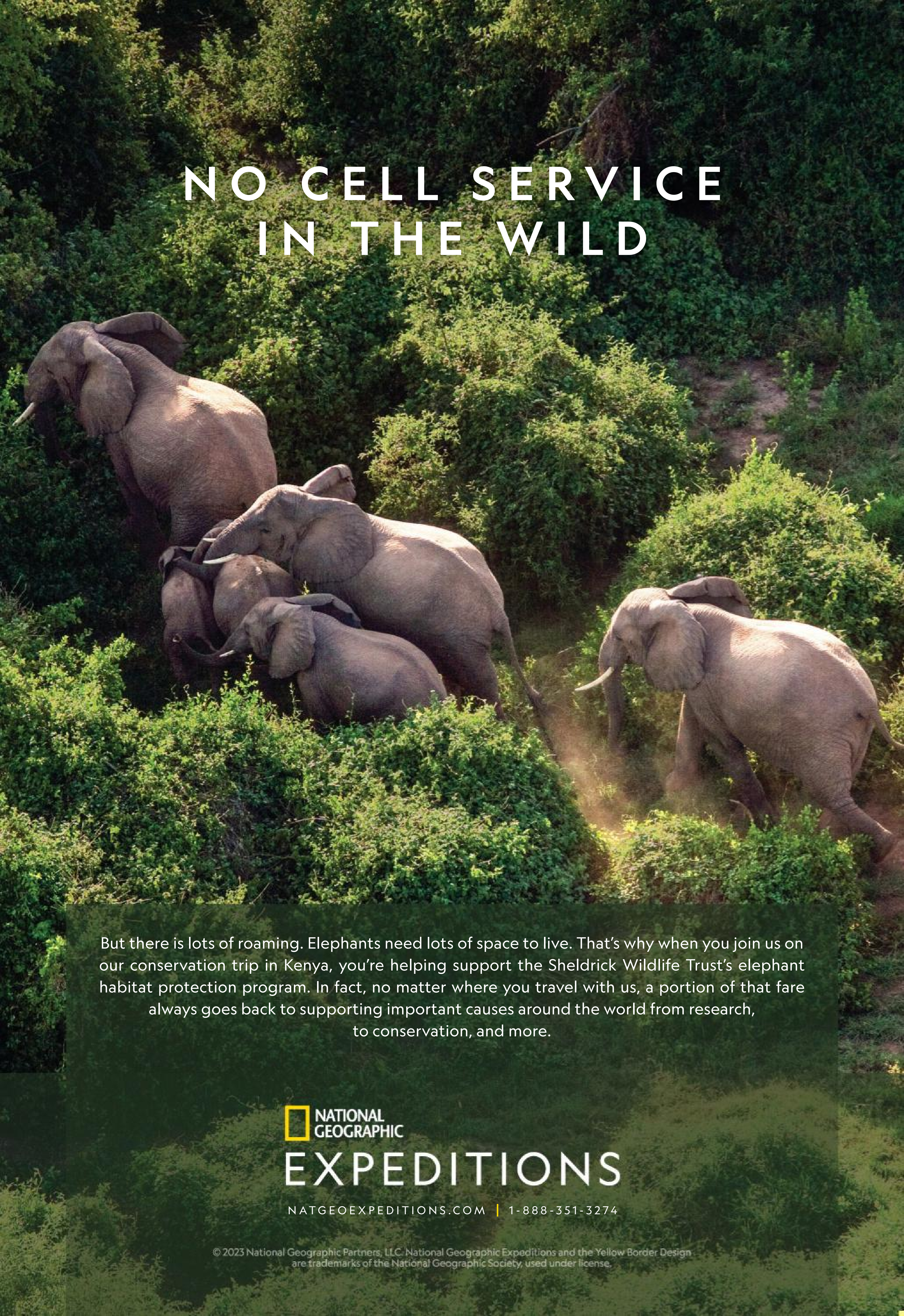
Scan this QR code to see all 10 of the contest's top photographs at *natgeo.com/photocontestwinner*.

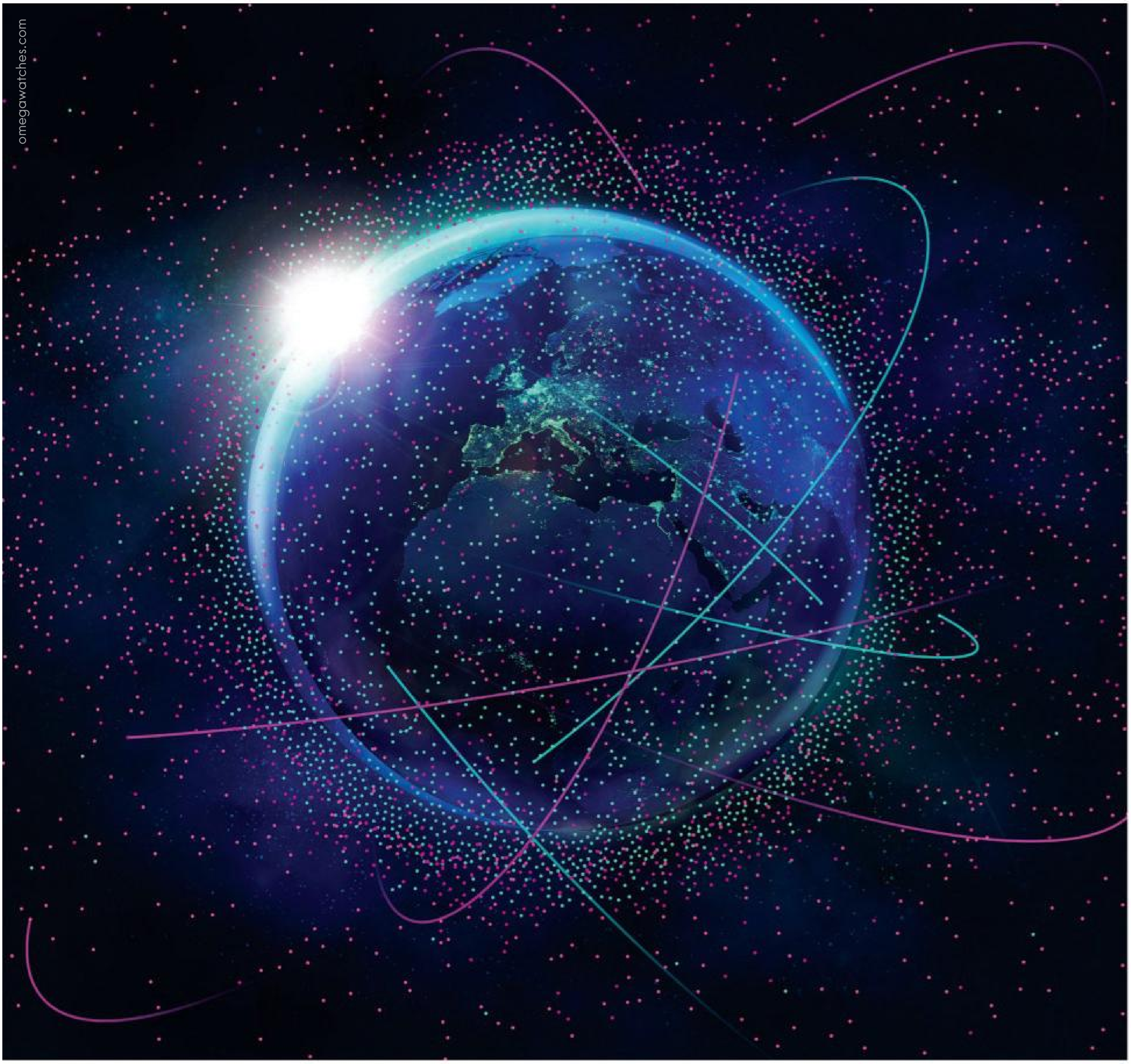
"Whenever there's salmon, there's going to be chaos." This became Karthik Subramaniam's motto as he watched for action at the water's edge on the final day of his visit to Haines, Alaska. Near the town, one of the world's largest congregations of bald eagles gathers every fall during the salmon run. He noticed a few eagles perched on a branch, seemingly waiting for their more adventurous peers to arrive ashore with a freshly caught fish. Then an eagle swooped in, displacing another to claim the prime spot. Subramaniam now marvels at the tension of the moment he captured. "It opens up the question, What happened next?" he says. The reality is less mysterious: The triumphant eagle appeared to get bored when no salmon appeared and soon surrendered the spot, leaving it vacant for the next hungry hopeful.

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